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Washington, D. C. ▼ April, 1926

FACTORS AFFECTING FARMERS' EARNINGS IN SOUTHEASTERN PENNSLYVANIA

By

MORDECAI EZEKIEL, Agricultural Economist
Bureau of Agricultural Economics

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By MORDECAI EZEKIEL, *Agricultural Economist, Bureau of Agricultural Economics*

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The study of farm organization and practice presented in this bulletin was undertaken, (1) to investigate the ways in which dairy farmers of the Piedmont Plateau region of the Atlantic coast were adapting their farm operations to the changed conditions following the World War period, and (2) to study the methods of organizing and operating their farms which make for greatest profits under these new conditions.

This bulletin is concerned primarily with the kind of farming which was most profitable during the year of the survey, and the kind which is likely to be most profitable in the future. The description of the changes in farming from pre-war to postwar conditions will be presented in a separate report.

BASIS FOR THE CONCLUSIONS

The southeastern portion of Chester County, Pa., was selected as the area in which to make the detailed farm study. During the summer of 1923 records for 422 farms were collected by the survey method, providing details of the farm operations and the financial records of the farms for the year April 1, 1922, to March 31, 1923.

Through the cooperation of the milk distributors the figures for the quantity of milk sold by the farmers and the cash receipts for milk were obtained directly from the distributors' books, thus providing a very accurate figure for milk sales, the principal source of income. Thanks are due both to the farmers and to the business men who cooperated in this study by giving necessary information.[1]

In taking the farm records, no special effort was made to select farms of any one type. Instead, the farms were visited just as they came, but no records were taken from farms which were not being operated on a business basis. Farms operated as parts of estates or as show places were excluded, as such farms were not representative of ordinary farming conditions.

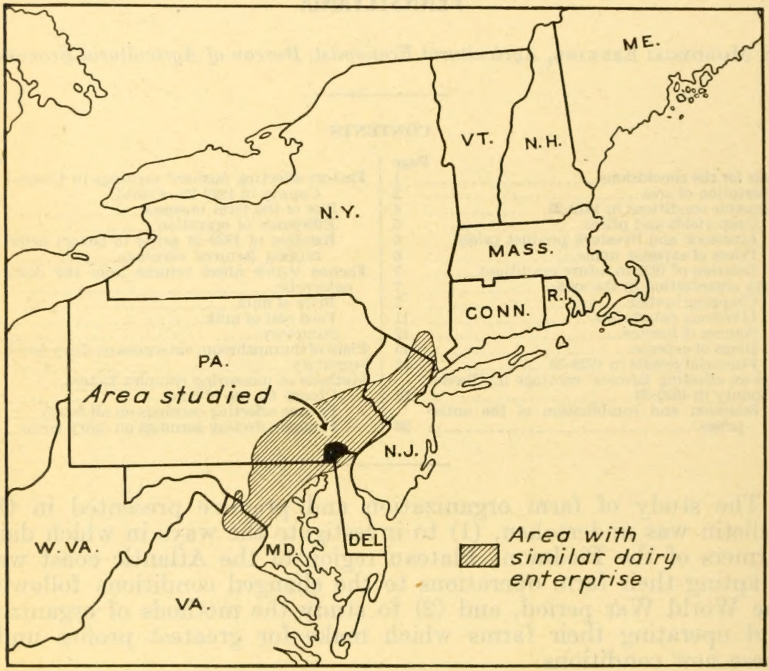

FIG. 1.—Location of Chester County, and of area where the records were obtained

DESCRIPTION OF AREA

All of the farms surveyed lie in the Piedmont Plateau region, an area of rolling topography and generally fertile soils (figs. 1 and 2). The area is one of unusually uniform soil conditions, thus eliminating much of the diversity in operations from farm to farm caused by soil differences. Long-continued dairying has maintained the soil in very productive condition, the yields of nearly all crops being much above customary yields in this part of the country. The bluegrass pastures, largely located along the stream bottoms, are unusually fertile with a carrying capacity that runs up to one cow per acre (fig. 3).[2]

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[1] The field work was done in cooperation with the Pennsylvania State College. Acknowledgment is due to J. E. McCord of that institution, and Jesse Tapp of the Bureau of Agricultural Economics, for planning the survey and initiating the field work, and to John Bohn, John W. Corman, William F. Hall, William M. McMahon, Joseph I. Stubbs, Ervin J. Utz, and Norman L. Wolf, who assisted in interviewing the farmers. The direct clerical work, both in the field and in the office, was under the supervision of Mrs. Henrietta Bettles. Thanks are due to her and to the corps of clerical assistants for their work on this investigation.

Milk production has long been the most important source of income (fig. 4) because of the rather heavy soil and the location within easy shipping distance of Philadelphia; but wheat and hay are also important items. Within recent years mushroom production has been introduced, either as a special business approaching factory production or as a supplementary enterprise fitted into regular farm operation. For this latter purpose the possibilities in mushroom production are of much interest to Chester County farmers, but the general efficiencies in dairy farm operation are more important to dairy farmers in other eastern regions, and are therefore discussed in greater detail here.

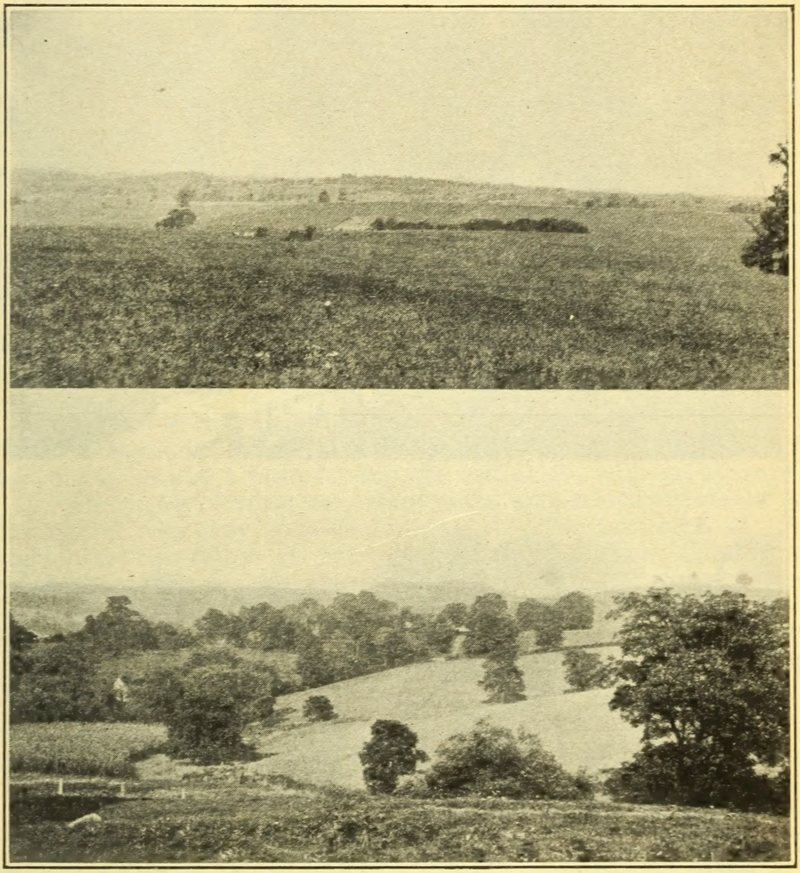

FIG. 2.—Chester County topography varies from gently rolling to rough. Most of the farms have some land too rough to plow, which is used for permanent pasture or woodlots

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[2] A more detailed description of this area is given in reference *(17)*. Hereafter italic figures in parentheses refer to "Literature cited," shown at the end of this bulletin.

ECONOMIC CONDITIONS IN 1922-23

Since the conclusions reached in this study are largely based upon the financial success of the different farmers during the year covered by the survey, it is necessary to examine the conditions which governed farm profits in this region to reach a conclusion as to how well that particular year represented either the average conditions in the past or the conditions which may be expected to prevail hereafter.

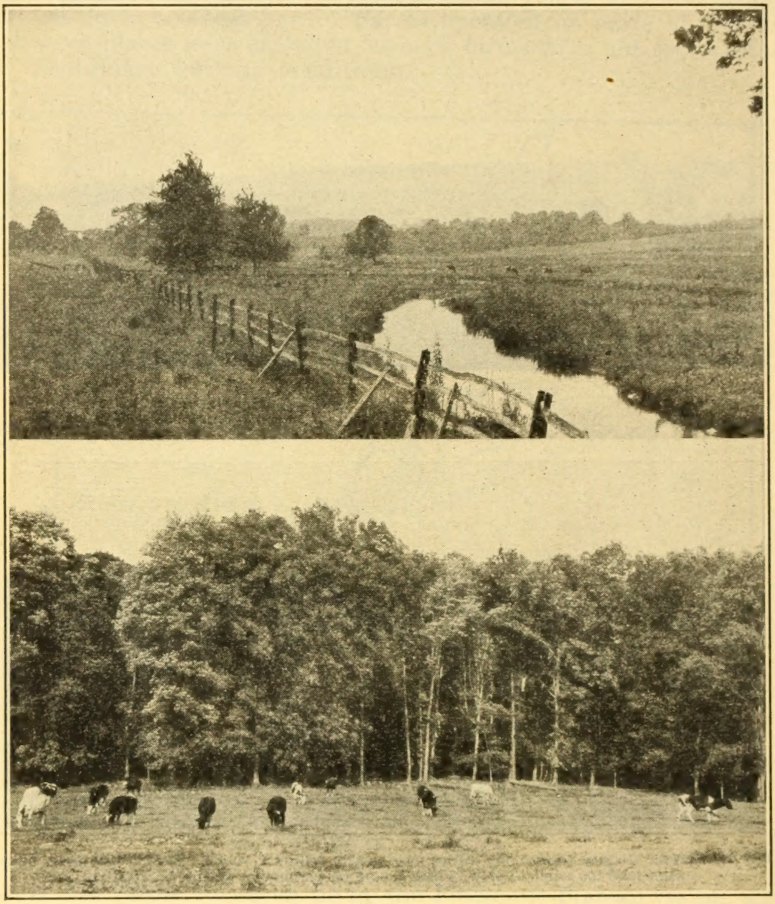

FIG. 3.—Typical pasture scenes. The lower picture shows the splendid natural timber growth and the rich blue-grass pasture

The net returns from any farm depend upon the value of the products sold and the costs incurred in their production. For crops, the value of the products depends upon both the yield per acre and the value per unit; for livestock and livestock products the value varies directly with the price and production. Factors which are largely beyond the control of an individual farmer and which cause his net return to vary from year to year, are the economic conditions which cause the prices he receives to vary and the weather variations which cause the yield and quality of his crops and the quality of his pasturage to vary. The following discussion will show how the conditions the year of the survey caused farm earnings to vary from those of other years, and also caused variations in the relative return on the different enterprises.

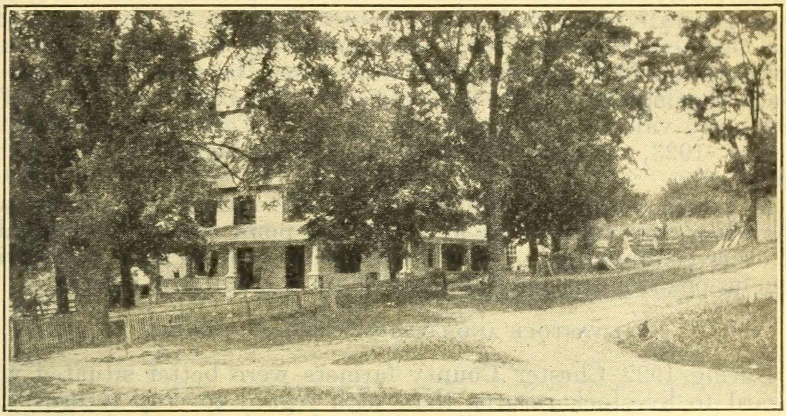

FIG. 4.—Dairy cows have been kept on this farm for many decades. This house was built in 1760

CROP YIELDS AND PRICES

Crop yields in this region are relatively uniform from year to year. In the nine years, 1915 to 1923, the highest average wheat yield for the county was 24.5 bushels, and the lowest 17, with an average of 21.1 The yields of other important crops were relatively stable over this period, the only notable failure being the hay crop of 1923, which was two-thirds of normal. During the same time prices, on the contrary, were undergoing violent fluctuations, because of the European war, the following inflation, and the succeeding deflation and readjustments. The effect of the variations in both yields and prices are reflected in the acre value of different crops, given in Table 1.

TABLE 1.—*Value per acre of Chester County crops, 1889 to 1923*

Year	Value per acre					
	Corn	Wheat	Oats	Rye	Hay	Potatoes
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1889	19.92	17.60	7.65	7.44	13.91	37.54
1899	20.91	11.09	10.64	8.82	13.69	38.14
1909	26.53	24.96	17.45	14.08	17.68	46.09
1915–1919	57.64	36.23	26.07	28.29	[1] 34.62	107.03
1920–1923	40.74	24.84	20.35	19.99	25.69	90.42
1922	32.16	21.38	17.51	16.85	24.85	61.38
Year	Acre-values, in per cent of 1909 values					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1889	75	71	44	53	79	81
1899	79	44	61	63	77	83
1909	100	100	100	100	100	100
1915–1919	217	145	149	201	196	232
1920–1923	154	100	117	142	145	196
1922	121	86	100	120	141	133

[1] 1917–1919 only.

From the Census of Agriculture, 1889 to 1909, and from the Pennsylvania State Department of Agriculture 1915 to 1923.

These values are averages for the whole county, rather than for the particular area surveyed. Yields in this area are higher than for the whole county, and the acre-values would likewise have been somewhat higher.

The values per acre of the different crops in 1922, the year of the survey, were much below those of the war period, 1915–1919, and were generally not much above those of 1909. Wheat was worth less per acre than in 1909; oats practically the same; corn and potatoes one-fifth and one-third more; hay, because of an unusual yield, was highest with 40 per cent above the 1909 acre value. The 1921 acre values were just about as low. The year following the survey, 1923, the acre values were somewhat higher for most of the crops.

As far as the crops were concerned, the year of the survey was one when crop values were at a very low point relative to the value of other commodities. This fact must be kept in mind in drawing conclusions from the profits obtained on the different farms.

LIVESTOCK AND LIVESTOCK PRODUCT PRICES

During 1922 Chester County farmers were better situated with regard to livestock returns than with regard to crop returns. As shown in Table 2, both milk and eggs brought prices about 40 per cent above the pre-war average. Beef animals and hogs sold relatively lower, but these are of minor importance.

TABLE 2.—*Prices of Chester County livestock and livestock products, annual 1922; and averages, 1890–1923*

Years	Milk per hundred-weight, Phila-delphia 60-mile zone	Eggs per dozen, New York	Steers per hundred-weight, Chicago	Hogs per hundred-weight, Chicago	Prices in per cent of the 1910–1914 average			
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Average:								
1890–1899	1.17	0.150	5.32	4.41	72	61	62	55
1900–1909	1.40	.196	6.37	6.02	86	79	74	75
1910–1914	1.63	.247	8.59	8.00	100	100	100	100
1915–1919	2.52	.393	13.91	13.66	155	159	162	171
1920–1923	2.79	.417	11.69	9.94	171	169	136	124
1922	2.32	.347	10.32	9.39	142	140	120	117

Milk prices from Inter-State Milk Producers' Association and the Report of the Governors' Tri-State Milk Commission for Pennsylvania, Maryland, and Delaware. Other prices from the Bureau of Labor Statistics, U. S. Department of Labor.

The prices of milk and eggs have since been well maintained, and both steer and hog prices have shown some recovery from the low levels of 1921 and 1922. With the prices shown it is evident that conditions in 1922 were more favorable in this region to the dairy and poultry enterprises relative to the cash crops, beef, or swine enterprises, than they were in previous years.

PRICES OF EXPENSE ITEMS

Although the gross income from crops and livestock in 1922 was not so much above the pre-war levels, many of the farmers' items of expense were still high. Threshing, horse shoeing, farm machinery, building materials, and many similar factors were still much above pre-war prices, but these are not very important items. As shown in Table 3, this was not characteristic of all expenses. Of four important items of expense—labor, feed, fertilizer, and taxes—mill feeds were, on the average, no higher than dairy products; acid phosphate was relatively as low as most crops; wages of farm labor, however, were further above the pre-war level than any of the farm products shown; while land taxes were still about as high as during the war, and much above the pre-war level. Altogether, the economic conditions of 1922–23 were quite different from previous conditions in the area.

TABLE 3.—*Prices of important items of expense of Chester County farmers, averages 1890–1923, annual 1922*

Years	Farm labor by month with board	Bran at Minneapolis, per ton	Cottonseed meal at New York, per ton	Acid phosphate at New York, per ton	Prices in per cent of the 1910–14 averages			
Average:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1890–1899	14.11		21.96		71		70	
1900–1909	18.19		27.75		92		88	
1910–1914	19.75	[1] 19.69	31.37	[1] 7.43	100	[1] 100	100	[1] 100
1915–1919	29.36	28.72	48.51	7.96	149	146	155	107
1920–23	38.25	26.29	51.57	13.83	194	134	164	186
1922	33.00	20.12	48.79	8.89	167	102	156	120

[1] 1913–14 only.

From the Bureau of Labor Statistics, U. S. Department of Labor, and the Division of Crop Estimates, Bureau of Agricultural Economics, U. S. Department of Agriculture.

RELATION OF 1922–23 TO FUTURE CONDITIONS

It is not possible to tell very definitely to just what extent future conditions will differ from those prevailing during the year of the survey. It seems fairly certain, however, that under ordinary conditions the cash crops and meat animals will return somewhat more than they did during that year relative to the dairy and poultry enterprises. It seems also reasonable to assume that, when the readjustment following the war period is complete, the prices of the various items of farm expense will not be so far out of line with the prices of farm products as they were during 1922. Taken altogether, the economic conditions in this region were such as to make the farm year 1922–23 one of rather low returns; and therefore the net earnings on various types of farms were probably somewhat lower the year of the survey than they would be under more stable conditions.

FARM ORGANIZATION IN THE AREA

CROPPING SYSTEM

The farms in this region vary widely in size and to some extent in the adaptability of the land to different uses. The crops grown and the livestock kept therefore vary somewhat with the possibilities of individual farms, as well as with the preferences of individual farmers. Dairy farming is the dominant type, as shown by the following classification of the 422 farms surveyed, based largely upon the principal source of cash income. Of the 422 farms—

270 were dairy farms with fair-sized herds.
38 were dairy farms with small herds and large poultry flocks.
25 were dairy farms with mushrooms as a supplementary enterprise.
27 were mushroom farms, some with cash crops as supplementary enterprises.
29 were cash-crop farms, selling grain and hay.
5 were poultry farms.
7 were small or "part-time" farms, with poultry as the principal enterprise.
3 were beef-cattle farms.
3 drew a large part of their returns from truck crops.
3 drew a large part of their returns from potatoes.
1 drew a large part of its returns from hogs.

In addition, six farms sold so much wood or lumber that they could not be placed in any of the above groups, and five farms had just begun operations during the year and had not yet developed any settled organization.

The average size of the farms and the crops grown in the more important of these groups are shown in Table 4.

TABLE 4.—*Average acreage in specified crops, by groups of farms*

Group of farms	Farms in group	Average size	Open pasture area	Crop area	Grain crops					Corn for silage or cut green
					Corn	Wheat	Oats	Other small grain [1]	Total	
	Number	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Dairy	270	105	23	61	12	11	4	(4)	27	4
Small dairy	38	78	18	43	10	8	3	1	22	3
Mushroom-dairy	25	115	27	65	12	11	2	(4)	25	4
Mushroom	27	58	12	34	8	4	2	--------	14	1
Crop	29	123	24	73	15	14	6	1	36	2
Poultry	5	61	15	30	8	3	--------	--------	11	2
Small poultry	7	52	9	19	5	3	2	(4)	10	(4)
Beef	3	130	51	64	4	12	5	--------	21	5
Truck crop	3	182	29	110	19	12	6	--------	37	4
Potato	3	90	16	57	10	11	2	--------	23	1

Group of farms	Hay crops							Potatoes	Commercial orchard [2]	Commercial truck	Commercial small fruits [3]	Total area in special crops
	Clover	Timothy	Clover and timothy	Alfalfa	Cowpeas and soy beans	Oat hay	Total					
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Dairy	9	10	2	5	(4)	(4)	26	3.1	0.2	0.2	0.1	4
Small dairy	5	6	1	4	(4)	(4)	16	1.7	.1	.5	--------	2
Mushroom-dairy	5	11	7	8	(4)	(4)	31	3.6	.6	.5	--------	5
Mushroom	4	7	1	3	(2)	1	16	1.5	.6	.5	--------	3
Crop	12	12	4	3	--------	(4)	31	3.5	.2	.3	.1	4
Poultry	4	6	1	3	--------	--------	14	1.9	.8	.6	--------	3
Small poultry	2	3	1	1	--------	--------	7	1.6	.7	--------	--------	2
Beef	14	18	--------	--------	--------	4	36	1.6	--------	--------	--------	2
Truck crop	5	5	37	2	--------	--------	49	3.3	8.9	6.8	.7	20
Potato	6	13	--------	4	2	--------	25	8.0	--------	--------	--------	8

[1] Includes rye, barley, and buckwheat.
[2] In this and the next two groups the term "commercial" means grown primarily for sale.
[3] Includes strawberries.
[4] Less than one-half an acre.

The differences in average size of the groups are not particularly important as they depend somewhat upon the way the farms were grouped. The differences in farming system are, however, partly due to differences in physical conditions.

The crops grown in each group are much the same regardless of the particular crop or livestock product which was most important. The standard rotation was described in United States Department of Agriculture Bulletin 341 as follows *(17)*:

First year	Second year	Third year	Fourth year	Fifth year
Corn	Corn (silage) Potatoes Oats	Wheat	Timothy and clover.	Timothy and clover.

This rotation still largely prevails, although, as shown in Table 4, alfalfa now occupies about one-fifth of the hay land on dairy farms and is an important crop on other types. On some farms alfalfa is grown as part of the regular rotation; on other farms the alfalfa fields lie outside of the regular cropping system, occasionally a new field being started and the old one plowed up.

Table 5, showing the percentages of crop land in the different crops, gives a better statement of their relative importance. As would be expected, silage is an important crop on only the dairy and beef farms, while the proportion of special crops is highest for the poultry, potato, and truck-crop farms. In general, however, the relative acreages of the different groups of crops, and even of the important individual crops, are surprisingly constant for all the different groups, indicating how generally all the farms tend to follow about the same cropping system.

TABLE 5.—*Percentage of area in specified crops, by groups of farms*

Group of farms	Percentage of total area in—		Percentage of crop area in—				Percentage of crop area in specified grain crops			Percentage of crop area in specified hay crops				Percentage of crop area in potatoes
	Pasture	Crops	Grain crops	Silage, etc.	Hay crops [1]	Special crops	Corn	Wheat	Oats	Clover	Timothy	Clover and timothy	Alfalfa	
Dairy	22	58	44	7	43	6	20	18	6	15	17	3	8	4.9
Small dairy	23	55	51	7	37	5	23	19	7	12	14	2	9	4.0
Mushroom-dairy	23	57	38	6	48	8	18	17	3	8	17	11	12	5.5
Mushroom	21	59	41	3	47	9	23	12	6	12	21	3	9	4.4
Crops	20	59	49	3	42	6	21	19	8	16	16	6	4	4.8
Poultry	25	49	37	6	47	10	27	10	-----	13	20	4	10	6.3
Small poultry	17	37	53	-----	37	10	26	16	11	11	16	5	5	8.4
Beef	39	49	33	8	56	3	6	19	8	22	28	-----	-----	2.5
Truck crops	16	60	34	4	44	18	17	11	6	4	4	34	2	3.0
Potato	18	63	40	2	44	14	18	19	3	11	23	-----	7	14.0

[1] Includes cowpeas, soy beans, and oats, cut for hay, as well as hay crops shown separately.

The dairy farms vary considerably in size, some having less than 30 acres in crops, and others having over 150. In general the larger farms have more cows; but, as shown in Table 6, there are wide variations in the number of cows kept on farms of about the same size.

TABLE 6.—*Dairy farms classified according to the number of crop acres and the number of cows kept*

Number of cows	Farms with specified acreage in crops											All sizes
	16 to 30 acres	31 to 45 acres	46 to 60 acres	61 to 75 acres	76 to 90 acres	91 to 105 acres	106 to 120 acres	121 to 135 acres	136 to 150 acres	151 to 165 acres	166 to 180 acres	
5 or less	1	2										3
6 to 10	12	32	20	7	1		1					73
11 to 15	3	19	25	21	10	4						82
16 to 20		6	23	16	16	6	3	1				71
21 to 25		2	5	3	7	6	1	1	1			26
26 to 30			2	1	4	2		1				10
31 to 35							1			2		3
36 to 40											1	1
41 to 45												
46 to 50			1									1
Total	16	61	76	48	38	18	6	3	1	2	1	270

As shown in Table 6, the smaller farms in general have more cows relative to their crop area than have the larger farms. This relation is shown more clearly in Table 7, which shows the average number of crop acres per cow for the more important groups in this classification.

TABLE 7.—*Average crop acres per cow, for dairy farms grouped by area in crops and size of herd*

Number of cows	Farms with specified acreage in crops						
	16 to 30 acres	31 to 45 acres	46 to 60 acres	61 to 75 acres	76 to 90 acres	91 to 105 acres	106 to 120 acres
	Acres per cow	*Acres per cow*	*Acres per cow*	*Acres per cow*	*Acres per cow*	*Acres per cow*	*Acres per cow*
5 or less	3.1	6.8					
6 to 10	2.8	4.6	5.8	7.2	7.9		11.9
11 to 15	2.3	3.3	4.1	5.2	6.2	6.9	
16 to 20		2.4	3.1	3.7	4.7	5.7	5.5
21 to 25		1.9	2.3	2.7	3.7	4.1	4.5
26 to 30			2.0	2.5	3.0	3.8	

The number of crop acres per cow varies from 1.9 acres to 11.9. Most farms have between 2½ and 6 acres. With this wide range in the intensity of stocking with cows there are corresponding differences in the cropping system. The extent to which these differences in the intensity of stocking are accompanied by differences in the cropping systems is shown in Table 8. Only the proportion of the land in each group of crops is shown, as the differences in the size of the farms would make it difficult to compare the actual acreages for the different groups.

TABLE 8.—*Percentage of land in certain crops for farms grouped by area in crops and size of herd*

Size of farm and herd	Percentage of crop area in—				
	Corn for grain	Corn for silage or cut green	Small grain	Hay other than alfalfa	Alfalfa hay
16 to 30 crop acres:	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5 cows or less	29	----------	12	41	18
6 to 10 cows	23	4	23	32	9
11 to 15 cows	35	4	19	31	----------
31 to 45 crop acres:					
5 cows or less	21	----------	32	35	3
6 to 10 cows	23	2	26	36	5
11 to 15 cows	22	5	28	32	5
16 to 20 cows	24	10	22	20	17
21 to 25 cows	16	19	16	16	28
46 to 60 crop acres:					
6 to 10 cows	23	2	26	34	6
11 to 15 cows	22	4	26	8	4
16 to 20 cows	19	9	26	30	9
21 to 25 cows	19	14	19	29	15
26 to 30 cows	20	4	15	28	29
61 to 75 crop acres:					
6 to 10 cows	18	3	25	46	4
11 to 15 cows	18	4	27	37	8
16 to 20 cows	18	6	24	36	11
21 to 25 cows	17	16	17	29	18
26 to 30 cows	14	15	15	15	----------
76 to 90 crop acres:					
6 to 10 cows	19	9	28	22	21
11 to 15 cows	18	6	28	37	6
16 to 20 cows	19	5	26	39	5
21 to 25 cows	20	6	25	38	6
26 to 30 cows	23	12	30	27	2
91 to 105 crop acres:					
11 to 15 cows	18	5	27	40	5
16 to 20 cows	17	7	34	30	9
21 to 25 cows	21	6	23	42	4
26 to 30 cows	16	16	21	32	10
106 to 120 crop acres:					
6 to 10 cows	23	----------	31	31	7
11 to 15 cows	----------	----------	----------	----------	----------
16 to 20 cows	19	4	29	40	4
21 to 25 cows	17	14	31	12	22

There is a very marked relation between the number of cows per crop acre and the distribution of crop acreage. The farms which kept fewer cows than the typical farm of the same size grew little or no silage, while the farms that had more cows than the usual farm of about the same size grew considerable silage. In most cases, too, the farms that had more than the usual number of cows grew more than the usual proportion of alfalfa hay. This shows that these two crops—corn for silage and alfalfa hay—which produce more than the usual quantity of nutrients per acre, are the means used by Chester County dairymen to increase the number of cows that their farms can carry.

LIVESTOCK ENTERPRISES

The farms in this region show only minor differences in the cropping systems, but there are wide differences in the kinds of livestock kept on different farms. In fact it is only on the basis of this difference in livestock enterprises that it is possible to make any separation of the farms into different groups, because they are nearly all essentially of the same type as far as the crops go.

TABLE 9.—*Average number of livestock per farm for specified groups of farms*

Group of farms	Farms in group	Size of farm	Dairy cows	Dairy cattle other than cows	Beef cattle	Hogs	Sheep	Chickens	Work stock	Horses per 100 acres in farm
	Number	*Acres*	*Number*	*Animal units* [1]	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Dairy	270	105	14.8	1.7	0.1	2.0	0.3	105	4.2	4.0
Small dairy	38	78	9.7	1.4	.9	4.1	2.2	175	3.3	4.2
Crop	29	123	6.2	1.0	1.5	6.1		107	4.6	3.7
Mushroom	27	58	1.5	.3	1.9	3.2	1.8	76	3.1	5.3
Mushroom-dairy	25	115	14.9	1.8		2.1		119	4.3	3.7
Poultry	5	61	7.2	.8		.1		314	2.6	4.3
Small poultry	7	52	4.0	.4		.4	.4	152	2.0	3.8
Beef	3	130	1.9	.2	17.8	2.3		110	3.3	2.5
Truck crop	3	182	10.2	1.0	1.7	12.5	42.3	138	6.0	3.3
Potato	3	90	7.0	.6	2.0	.8		168	3.0	3.3

[1] Counting young heifers or calves as one-half unit, and mature animals as 1 unit.

The typical dairy farm in this region has no beef cattle, hogs, or sheep, the small figures shown in the dairy group for these animals in Table 9 representing occasional exceptions. Some farms raise all their own cows, but most do not raise enough heifers to maintain the herd.

On small dairy farms poultry and hog enterprises were more important than on the regular dairy farms, and an occasional farm in this group kept sheep.

The crop farms had small dairy herds or none at all, and somewhat more hogs and beef cattle than the dairy farms. Only about as many chickens were kept, however, as on the dairy farms.

The "mushroom-dairy" farms—those dairy farms where mushrooms were grown as a supplementary enterprise—kept just about the same livestock as the dairy farms, but on the mushroom farms where the dairy enterprise had been dropped, hogs, beef cattle, or sheep were added in many cases.

In the other groups the livestock were as would be expected from the designation. On poultry farms the dairy enterprise had been still further subordinated to the poultry enterprise than on the small dairy farms, and the small poultry farms were largely part-time farms run on a small scale. The other groups represent special types or unusual conditions.

The number of horses for each group, as shown in Table 9, is rather uniform in relation to the number of acres, though the usual tendency for the larger farms to have more acres per horse is evident.

SOURCES OF INCOME

By far the greatest part of the cash receipts of farmers in this reregion comes from dairy products. As shown in Table 10, dairy products brought in over $2,000 on the average for the dairy and mushroom-dairy farms, and over $1,000 on the small dairy and truck-crop farms. Crops, dairy cattle (including veal calves), and poultry ranked next in the order given on dairy farms, and on the small dairy farms poultry was a much more important source of income than either crops or dairy cattle.

As shown in Table 11, dairy products were responsible for at least one-fifth the total receipts on all the principal types of farms except the mushroom farms, whereas crops sold totaled less than one-fifth the total on all except the crop farms.[3]

TABLE 10.—*Sources of cash income on farms of specified groups*

Group of farms	Farms in group	Cash receipts from various sources						
		Total	Crops	Mushrooms	Dairy cattle	Dairy products	Poultry	Other livestock and miscellaneous
	Number	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Dairy	270	3, 437	654	----------	305	2, 107	292	79
Small dairy	38	2, 631	337	----------	167	1, 210	653	264
Crop	29	2, 598	1, 133	----------	116	572	317	460
Mushroom	27	6, 406	356	5, 069	38	84	343	516
Mushroom-dairy	25	7, 432	977	3, 651	314	2, 107	312	71
Poultry	5	3, 276	146	----------	504	551	1, 983	92
Small poultry	7	1, 144	213	----------	54	268	517	92
Beef cattle	3	6, 495	793	----------	163	36	246	5, 257
Truck crop	3	6, 269	3, 101	----------	417	1, 045	608	1, 098
Potato	3	3, 439	1, 714	----------	126	681	598	320

TABLE 11.—*Proportion of cash income from different sources on farms of specified groups*

Group of farms	Farms in group	Percentage of cash receipts from different sources						
		Total	Crops	Mushrooms	Dairy cattle	Dairy products	Poultry	Other livestock and miscellaneous
	Number	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Dairy	270	100	19	----------	9	61	9	2
Small dairy	38	100	13	----------	6	46	25	10
Crop	29	100	44	----------	4	22	12	18
Mushroom	27	100	6	79	1	1	5	8
Mushroom-dairy	25	100	13	49	4	29	4	1

In addition to the products sold, considerable quantities of farm products were consumed on the farm, as given in Table 12. The value of these averaged about the same in all of the important groups, running usually just under $100 worth of crops and $200 worth of livestock and livestock products per farm.

Wheat, potatoes, and timothy hay were the most important individual crops sold, except in the mushroom groups. Clover hay and corn were also important items on the crop farms. Potatoes and vegetables were the important crops used by the farm family in all groups.

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[3] No study was made of tenure relations in this analysis. The receipts, expenses, and earnings for all farms are therefore shown as if they had all been operated by owners. That is, the monetary figures shown in subsequent tables include for rented farms both the tenants' and the landlords' shares in the business given together.

TABLE 12.—*Average value of crops sold or used by farm family, by farms of specified groups*

Item	Groups of farms				
	Dairy	Small dairy	Mushroom	Mushroom-dairy	Crop
Number of farms	270	38	27	25	29
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Total crop income	748	435	5,706	4,725	1,251
From cash sales	654	337	5,625	4,628	1,133
From family use	94	98	81	97	118
Cash sales by groups of crops:					
Grain	234	105	81	219	453
Hay and roughage	260	122	174	471	414
Potatoes	141	68	35	203	173
Mushrooms	------	------	5,069	3,651	------
Other crops	19	42	[1] 266	84	93
Family use by groups of crops:					
Grain	5	7	3	------	20
Potatoes	26	30	22	30	25
Vegetables	52	49	45	52	59
Fruit	11	12	11	15	14
Crops sold, itemized:					
Corn	31	4	9	24	128
Oats	2	------	------	1	12
Wheat	201	101	72	194	313
Timothy	128	66	43	187	197
Clover	60	22	47	111	143
Alfalfa	62	29	61	163	36
Straw and stover	10	5	23	10	38
Potatoes	141	68	35	203	173
Mushrooms	------	------	5,069	3,651	------
Fruit	12	8	36	5	63
Sweet corn	3	1	18	12	------
Other vegetables	4	33	12	67	30

[1] Includes $200 from greenhouse products.

The income from poultry was about two-thirds from eggs and only one-third from the sale of fowls, as shown in Table 13. Hogs serve as a minor source of income and are apparently kept nearly as much for the family use as for sale. The poultry and dairy enterprises contribute about equally to the family living, with hogs much less important.

TABLE 13.—*Value of principal livestock and livestock products sold and used by farm family on farms of specified groups*

Item	Group of farms				
	Dairy	Small dairy	Mushroom	Mushroom-dairy	Crop
Number of farms	270	38	27	25	29
Total livestock income:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Cash sale [1]	2,776	2,272	781	2,803	1,438
Family use [1]	183	190	193	199	190
Cash sales:					
Dairy products	2,107	1,210	85	2,107	572
Dairy cattle	305	167	38	314	116
Beef cattle	8	141	183	21	160
Hogs	54	89	103	28	46
Sheep	3	11	30	------	92
Eggs	173	459	259	199	165
Chickens	94	168	64	92	125
Turkeys	25	26	12	21	27
Family use:					
Dairy products	78	76	114	96	80
Dairy cattle	5	6	2	6	6
Hogs	28	31	19	23	50
Eggs	38	40	34	38	28
Chickens	29	36	23	34	24

[1] Includes miscellaneous items not listed separately below.

The receipts from crops would have been somewhat larger had crops been worth as much in relation to dairy and poultry products as they ordinarily are; but even with that qualification the predominance of livestock enterprises in general and the dairy enterprise in particular, as sources of receipts in this region, is striking.

It is evident that mushrooms produce a very large average gross return. The place of this enterprise on Chester County farms will be given special consideration later, in view of its importance.

ITEMS OF EXPENSE

The average cash expenses on farms in different groups is shown in Table 14. Direct expenses on the mushroom enterprise are grouped together and presented in itemized form later on.

Aside from the mushroom enterprise, expenditures for materials make up the most important group of expenses in every group of farms shown (Table 15). Labor is next in importance, with real-estate expenses next.

Feed is the outstanding item on dairy farms, and fertilizer is also important in every group. Repair and replacement of machinery is also an important item.

Besides labor hired, many specialized jobs are hired done, the expenditure for special service being about half as great as for labor in several groups. This illustrates the extent to which such parts of farm operations as can be more economically performed on a large scale or by specialists tend to become separated from the family farm business as such.

TABLE 14.—*Average cash expenses of farms in specified groups*

Item	Expenses by groups of farms				
	Dairy	Small dairy	Mushroom	Mushroom-dairy	Crop
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Total cash expenses	2,458	2,004	5,282	4,771	2,027
Materials purchased:					
Feed	434	396	123	485	156
Fertilizer	157	102	63	126	181
Lime	31	21	20	30	11
Seed	71	47	41	93	77
New machinery and repairs	143	165	168	208	132
Fuel and oil	25	15	16	22	14
Twine	7	5	3	6	8
Miscellaneous [1]	23	22	22	56	22
Total materials	891	773	456	1,026	601
Labor:					
Cash expense for labor	412	227	825	877	314
Cash expense for board for labor	75	25	64	35	45
Total cash for labor	487	252	889	912	359
Services purchased:					
Baling	41	19	25	60	63
Threshing	33	23	16	29	51
Feed grinding	32	18	12	26	23
Horse shoeing	28	24	23	29	28
Milk hauling	29	14	----------	27	13
Silo filling	7	3	1	10	3
Veterinary	15	7	6	9	7
Farm use of telephone	12	10	10	19	6
Cow testing	2	1	----------	1	1
Miscellaneous [2]	5	9	8	13	2
Total services	204	128	101	223	197

[1] Includes plants and trees, spray material, ice, barrels, and other containers, bedding, etc.
[2] Includes breeding and registration fees, electricity, machine hire, etc.

TABLE 14.—*Average cash expenses of farms in specified groups*—Continued

Items	Expenses by groups of farms				
	Dairy	Small dairy	Mushroom	Mushroom-dairy	Crop
Automotive expenses:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Farm use of automobile	56	45	121	102	44
Tractor expense	19	16	34	43	27
Total automotive	75	61	155	145	71
Real estate costs:					
Taxes	164	124	130	202	156
Insurance	42	29	66	77	36
Building repairs and improvements	184	282	518	190	108
Total	390	435	714	469	300
Interest paid	121	85	55	169	111
Livestock purchased	290	270	261	215	388
Direct expenses on mushroom enterprise [3]			2,651	1,612	

[3] Given in detail in Table 36.

TABLE 15.—*Distribution of expenses, except for livestock purchased, for groups of farms*

Item	Group of farms				
	Dairy	Small dairy	Mushroom	Mushroom-dairy	Crop
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Materials purchased	41.1	44.6	9.1	22.5	36.7
Labor	22.5	14.5	17.7	20.0	21.9
Services purchased	9.4	7.4	2.0	4.9	12.0
Automotive expense	3.4	3.5	3.1	3.2	4.3
Real-estate costs	18.0	25.1	14.2	10.3	18.3
Interest paid	5.6	4.9	1.1	3.7	6.8
Mushroom expense			52.8	35.4	
Total [1]	100.0	100.0	100.0	100.0	100.0

[1] Excluding livestock purchased.

Automobiles are in use on over half the farms surveyed,[4] and tractors are used on a number of farms, but automotive expenses make only a very small part of the total expenses. On the dairy farms they amounted to only about one-sixth as much as hired labor.

The mushroom-dairy farms hired an average of $425 more regular labor than did the dairy farms; the mushroom farms hired $530 more labor than did the crop farms. Since in both cases the mushroom farms sold no more crops or livestock and products than did the corresponding non-mushroom farms, this extra labor expense must be considered as due primarily to the mushroom enterprise, and must be kept in mind in considering direct expenses for the mushroom enterprise shown in Table 36.

Interest on indebtedness, and taxes, insurance, and building upkeep, amounted to about one-quarter of the expenses, except on the farms that grow mushrooms. Taxes alone ranked as an important item of expense on all farms.

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[4] For details of the use and costs of automobiles in this and other areas see (*21*).

FINANCIAL RESULTS IN 1922–23

In addition to the products sold for cash the operations for the year of the survey must be credited with any increases in the value of livestock or crops on hand at the end of the year. The yield of hay in this area in 1922 was unusually heavy, averaging 1.7 tons for the county against an average yield of 1.4 tons over the period 1917 to 1923. Partly as a result of this heavy yield of hay, on most farms more feed crops were carried over to the pasture season of 1923 than to the pasture season of 1922. In addition to this, many farms had more livestock on hand at the end of the year.

Besides the increase in inventory, the value of farm products consumed by the family must be included to obtain a complete statement of the products for the year. Although not a cash item, this represents a real part of the income produced, especially since any milk, eggs, or hogs not used could have been readily sold.

Table 16 brings together the receipts and expenses for the more important groups of farms. For the dairy farms the cash receipts, family use of farm products, and increase in inventories averaged $3,843, more than other group of farms except those growing mushrooms.

TABLE 16.—*Financial results for specified groups of farms*

Item	Dairy	Small dairy	Mushroom-dairy	Mushroom	Crop
Number of farms	270	38	25	27	29
Average acres	105	78	115	58	123
Average acres in crops	61	43	65	34	73
Average number of dairy cows	14.8	9.7	14.9	1.5	6.2
Value of products:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Products sold [1]	3,437	2,631	7,432	6,406	2,598
Farm products used by family [2]	274	306	332	268	308
Gains in inventory	132	157	35	210	371
Total value of products	3,843	3,094	7,799	6,884	3,277
Charges against products:					
Cash expenses except land and interest charges	1,947	1,484	4,133	4,513	1,616
Value of family labor	288	387	460	199	325
Charge for use of real estate and capital [3]	594	439	760	501	613
Total charges	2,829	2,310	5,353	5,213	2,554
Operator's earnings	1,014	784	2,446	1,671	723
Less value of operator's labor including perquisites	1,022	997	1,051	982	1,016
Management earnings	−8	−213	1,395	689	−293

[1] Includes some miscellaneous items not shown in previous tables.
[2] Includes firewood; excludes products used by hired men.
[3] At 4 per cent for real estate and 6 per cent for working capital.

Besides the cash expenses the charges against the product also include the value of the family labor and a charge for the use of land and capital. This latter is computed at 6 per cent on working capital given in Table 17, and at 4 per cent on that part of the real estate used in the farm business.[5] The value of the dwelling was not included, because no allowance was made for the value of its use by the farmer. Taxes, interest, and other land charges would have to be paid out of the 4 per cent covering the entire land charge.

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[5] In this area farms rent for cash for about 4 per cent of their sales value, according to the data obtained in the 1920 census (4).

These charges against the product totaled $2,829 on the dairy farms, leaving the operator $1,014 for his pay for the year. These farmers had estimated that they would have had to pay $1,022 in cash and perquisites to hire done the labor that they did themselves, and this indicates that during 1922–23 the dairy farmers made, on the average, only pay for their labor with nothing over as pay for their management of the farms.

TABLE 17.—*Distribution of investment for specified groups of farms, April 1, 1922*

Item	Dairy farms	Small dairy	Mushroom-dairy	Mushroom	Crop
Working capital:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Total	3,619	2,643	4,467	2,006	2,831
Livestock	2,076	1,518	2,275	718	1,406
Machinery	1,135	816	1,568	896	1,067
Crops on hand	243	178	242	101	208
Cash	165	131	382	291	150
Real estate:					
Total	12,650	10,189	16,097	13,842	14,389
Dwelling house	3,228	3,178	3,797	4,326	3,310
Land and other buildings	9,422	7,011	12,300	9,516	11,079

The differences between the average operator's earnings for the different groups of farms shown in Table 16, were not nearly so great as were the differences between their cash sales. The expenses on the mushroom farms were about double those on the other farms, the extra expense being principally for labor, manure, spawn, baskets, freight, etc. Even so, the average operator's earnings on the mushroom farms, with but 58 acres, were more than $600 above the average for the dairy farms, with 105 acres. The mushroom-dairy farms showed operator's earnings more than twice those of dairy farms, with about the same acreage and the same number of cows. Although the men who were combining mushroom production with dairy farming made the greatest profits, it must be remembered that a high degree of skill and management are required to run two such complicated businesses in combination and that not all farmers have this ability. Moreover, if all farmers in the area were to start growing mushrooms, they could not expect to receive such favorable prices as those of 1922 for the greatly increased supply.

The crop farms, though somewhat larger than the dairy farms, showed earnings one-third lower. At this point it should be remembered that in 1922 crops were relatively lower in price than were dairy and poultry products. Had the crops sold been worth one-fifth more, which would have brought them to about the usual parity with dairy products, the cash income of the crop farms would have been increased by about $230, while the income of the dairy farms would have been increased but $130. Under these prices the operator's earnings on the dairy farms would have been about $190 higher than on the crop farms, instead of $290 as in 1922–23. But it would seem that even under more typical price conditions the dairy farms would be decidedly more profitable than the crop farms.

The small dairy farms, with but 78 acres and 9.7 cows on the average, showed operator's earnings of $784, three-fourths as much as the average earnings on the larger dairy farms.

Whether mushroom production will continue to be as profitable as it was in 1922–23 will depend upon how much the demand for mushrooms can be expanded and how large a supply of manure or other suitable material for growing the mushrooms can be obtained without raising the cost too much. So far the demand for mushrooms has seemed very elastic, taking all that were offered at remunerative prices. Only experience can show what is the limit.

There were so few farms in each of the groups not shown in Tables 10 to 16, that the details of their financial records were not significant. However, it is of interest to note in passing that the average operator's earnings on the truck-crop farms was $2,177, and on the potato farms $1,549. (As will be seen from Table 9, these were really dairy farms with the specified enterprises added.) The operator's earnings on the poultry farms averaged $1,602 and on the small poultry farms $627, and the beef farms showed average earnings of minus $96. Of course several of the small poultry farms were only part-time businesses, and the average cash value of the operator's labor on them was only $543. From this it appears that when some special enterprise, such as truck crops or potatoes or a large poultry flock, is combined with dairy farming, good returns may be obtained, particularly if the farm is very favorably situated with regard to the production or the marketing of the special product, as was the case with most of these special farms. On the other hand, when no dairying was done, and the crops were fed to steers or hogs instead, not only were no profits made, but heavy losses resulted. Of course both steers and hogs were at low prices in 1922, but even had their prices been at the usual relation with milk prices, these farms would not have paid. The Iowa type of corn, steer, and hog farming can not compete with dairying on the Atlantic coast.

FIG. 5.—Steers on pasture near Doe Run. Only on those farms with unusually large areas of rich pasture like this did steers prove profitable

On some farms, where there was much more permanent pasture than could be used to advantage by the dairy cows, steers were run in addition to the dairy animals. In these cases the steers made a satisfactory and profitable means of utilizing the surplus pasture, but that was apparently as far as it paid to introduce beef cattle on farms in this region.

FACTORS AFFECTING FARMERS' EARNINGS IN CHESTER COUNTY IN 1922-23

SELECTION AND COMBINATION OF THE ENTERPRISES

The comparison of the earnings of the different groups in Table 16 brings out the point that proper selection and combination of the different crop and livestock enterprises are the first requirements for profitable farming. Leaving out the mushroom farms, a statistical study shows that the differences in operator's earnings on the farms surveyed were closely related to differences in the receipts from the different livestock and crop enterprises.[6] The three enterprises of greatest importance were the dairy enterprise, the poultry enterprise, and cash crops. Nearly all of the differences in earnings due to differences in the combination of enterprises were due to differences in these three enterprises, sheep, hogs, and beef animals being important on only a few farms.

As has already been indicated by the financial results for special farms, beef production and hog production much beyond that required for home consumption seem unprofitable for Chester County. So few sheep were found that it was obvious that they had not proved profitable in the area.

For most farms in this region it was more profitable to market the feed crops through dairy cows and chickens than to sell cash crops. Where potatoes can be grown as a supplementary crop without extra expense for hired labor and are properly cared for, they should add to the farm profits. There was such a wide variation in potato yields the year of the survey that it was not possible to measure the average effect of the area of potatoes upon the operator's earnings.

On some of the smaller dairy farms much larger poultry flocks were kept than on other farms of the same size. The general result of the study of these farms was that it did not pay most farmers to increase the number of chickens kept to such an extent that it was necessary to cut down the size of the dairy herd.

The combination of the different crops to produce a maximum of product at a minimum of cost is undoubtedly an important factor in profitable farming. But under the relatively low crop prices prevailing during the year of the survey it made very little difference how much of the feed for the dairy herd was raised on the farm. Statistical study showed that on the average there was a very slight decrease in earnings for each increase in the proportion of the feed purchased, but that this relation was not very significant. Though under the unusual price conditions the year of the survey it made little difference whether a farmer raised or purchased his feed, so far as the earnings for a herd of a given size were concerned, in years when purchased feeds are more expensive in relation to farm-raised feeds than they were in 1922 it would apparently pay to feed the cows more largely on home-grown feed.

SIZE OF THE FARM BUSINESS

The size of the operation is an important factor affecting the profits in almost any type of business enterprise. The larger the enterprise the larger the profits in a sucessful year and the larger the losses in an unprofitable year.

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[6] Correlating operator's earnings with crop receipts, dairy receipts, beef receipts, hog receipts, sheep receipts, and poultry receipts gave a multiple correlation of $R=0.729$. See discussion on page 56.

For the farms on which no mushrooms are produced the number of crop acres is one of the best indexes of size as far as area operated is concerned. This one factor alone accounted for nearly 12 per cent of the total variation in operator's earnings on these farms. Taking account of the number of cows in the dairy herd as well as the crop acres, these two size factors accounted for 19 per cent of the total variation in earnings, after eliminating from earnings differences in the efficiency of dairy operation. Differences in the crop area and in the size of the dairy herds were responsible for one-fifth of the differences in incomes on the regular farms of this area.[7]

TABLE 18.—*Average operator's earnings on dairy farms, according to the number of crop acres and the number of cows kept* [1]

Number of cows	Acreage in crops						
	16 to 30 acres	31 to 45 acres	46 to 60 acres	61 to 75 acres	76 to 90 acres	91 to 105 acres	106 to 120 acres
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
6 to 10	[2] 600	670	670	710	---	---	---
11 to 15	980	810	950	960	610	290	---
16 to 20	---	1,870	950	1,340	1,120	1,670	1,320
21 to 25	---	---	1,480	660	1,320	1,550	---
26 to 30	---	---	---	---	1,810	---	---
All size herds	680	870	970	1,050	1,110	1,280	1,040

[1] These two factors, including the effects of such other factors as tend to vary with them, have a multiple correlation of but $R=0.42$ with operator's earnings In interpreting this table it must therefore be remembered that these are by no means the most important causes of differences in earnings.

[2] Figures shown only for groups of three or more farms, and only to the nearest $10.

Table 18 shows how the average operator's earnings varied on the dairy farms with differences in the number of cows and the area in crops. In general, the more cows that were kept on a given acreage in crops the higher were the profits, but the acres of crops that were grown for a given number of cows had little effect upon the profits. In most groups the farms with 21 to 25 cows made $500 to over $1,000 more than did the farms with 11 to 15 cows. Taking farms with the same number of cows, farms of 61 to 75 crop acres in two cases showed average operator's earnings a little above the farms of 31 to 45 crop acres, but in one case much lower. Since the larger farms in general kept more cows, the average operator's earnings for all the farms of given size-groups were larger for the larger farms.

TABLE 19.—*Average operator's earnings on groups of farms, by acres in crops*

Acres in crops	Dairy farms		Small dairy farms		Crop farms		Mushroom-dairy farms		Mushroom farms	
	Farms	Operator's earnings	Farms	Operator's earnings	Farms	Operator's earnings	Farms	Operator's earnings	Farms	Operator's earnings
	Number	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*
Under 15	---	---	2	240	---	---	---	---	9	1,380
16 to 30	16	680	11	460	2	660	3	550	8	1,630
31 to 45	61	870	12	800	4	200	2	1,330	2	440
46 to 60	76	970	6	1,260	5	190	6	1,160	3	2,610
61 to 75	48	1,047	5	1,380	6	290	7	4,660	2	2,110
76 to 90	38	1,110	---	---	7	1,040	3	2,150	3	1,910
91 to 105	18	1,280	---	---	1	---	1	---	---	---
106 to 120	6	1,040	---	---	2	1,600	2	1,170	---	---

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[7] These statements are based on the multiple correlation study described on page 57.

This same general relation between size and operator's earnings held for farms of other types (Table 19). For the small-dairy group of farms—dairy farms with large poultry enterprises—and the mushroom-dairy farms the larger the farm (and hence the greater the number of cows) the larger the earnings. For the crop farms and the mushroom farms, however, there was but slight relation between the areas in crops and the earnings. On these farms more acres did not mean more cows, as they did on the other three types. This shows again the importance of the size of the dairy herd as a determinant of farm profits in this region.

EFFICIENCY OF OPERATION

The previous tables have shown the relation to farm earnings of the combination of enterprises and the size of the business, without making any mention of the relation of the efficiency with which the different operations were conducted to farm earnings.

"Efficiency" is a term which is frequently used with only a hazy idea of exactly what is meant. For the purpose of this discussion, it may be more sharply defined as the relation of the value of the product from any given enterprise to the cost of the things directly used in producing that product. Thus the efficiency of the dairy enterprise may be approximately measured by the extent to which the milk and veal calf, if any, produced by each cow exceeds the value of the feed consumed. This excess of the value of the product over the most important cost will be used as an index of efficiency for the dairy enterprise.

To get a similar index of the efficiency with which crops are produced, it would be necessary to deduct from the value of each kind of crop produced the principal costs—fertilizer, seed, and labor—used in producing it. Since no satisfactory data of the differences in crop production requirements on the different farms were obtained, it was necessary to leave them out of account, and to use merely the differences in crop yields as a measure of the efficiency of the crop enterprise.

In this region the variations in practices in crop production from farm to farm are much less than are the differences in the handling of the livestock, so this omission is not so serious as would be the same usage for the dairy enterprise or for crops in other areas where there are wider variations in crop-production efficiency.

Hence the standard crop index, which expresses the average relation between the yields of each crop on a given farm and the average yield for the area, is taken as the index of the efficiency of crop production. A crop index of 110 for a given farm means that on the average the crops of that farm were 10 per cent above the average yield per acre for each crop; one of 80 would mean that the yields averaged 20 per cent below the average for the area.

A considerable part of the expenses paid by farmers in this region is for labor, so it would seem that the efficiency with which human labor is used would be one important factor in determining farm earnings. There is normally a considerable variation in the labor on different farms, both with the area in crops and the number of cows kept. This normal difference in labor would have to be allowed for, before comparing the labor used on different farms to obtain a measure of efficiency.

TABLE 20.—*Average months of man-labor used on dairy farms, according to the area in crops and the number of dairy cows* [1]

Number of cows	Acreage in crops			
	27.5 acres	47.5 acres	67.5 acres	87.5 acres
	Months	*Months*	*Months*	*Months*
6	14.3	19.8	24.1	----------
10	15.7	20.7	25.0	27.1
14	16.0	21.5	25.6	28.0
18	----------	22.3	26.1	29.0
22	----------	22.9	26.5	29.8
26	----------	23.5	26.9	30.2

[1] The figures in this table are not simple averages, but are the smoothed averages or a "regression surface." This surface correlates with the actual labor on the individual farms to $\rho=0.68$.

Table 20 shows the average labor used on dairy farms according to size in both cows and acres. A farmer who used only as much labor as that shown in the table for his size operation would be using just the average for the size of his business; one who used more would be using more than the average, and consequently would be making inefficient use of the labor unless he was able to get a sufficiently large extra product to offset the cost of the extra labor. Similarly a farmer who used less labor than average would be making more efficient use of his labor, unless the value of the product was cut down just as much as was the expense for labor. The difference between the labor used on each farm and the averages shown in Table 20 may be used, at least tentatively, as an index of efficiency in the use of labor.

The relative importance of the efficiency with which the farm is operated, as compared with the size of the business, was determined by a statistical study of the dairy farms. This study showed that on the dairy farms the efficiency of operation was more than twice as important as the size of the business in determining operator's earnings. Differences in the efficiency of the dairy enterprise alone were responsible for two-fifths of the entire differences in earnings on the dairy farms, while differences in the efficiency of crop production, as measured by the crop index, were responsible for 7 per cent of the differences in operator's earnings. Thus efficiency in milk production was by far the most important factor in determining earnings on dairy farms.

The index of labor efficiency was found to have practically no relation to the differences in earnings. This proves that the index was not a good measure of labor efficiency, since the farmers who used more than the average labor got enough more than the average product to pay for it. This means merely that in this region most farmers were making very efficient use of human labor, at least as between farms of the same size and with the same number of cows. The fact that on a farm of a given size twice as many cows were handled with only slight increase in labor force is probably one reason why earnings increased so rapidly, as more cows were kept on a farm of a given size.[8]

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[8] The statements in this and the preceding paragraph are based on a multiple correlation of operator's earnings on the dairy farms with several factors, discussed in pages 57 to 59.

The number of cows and the dairy index together accounted for 55 per cent of all the variation in operator's earnings on the dairy farms, or for all but one-sixth of the variation in earnings on these farms that could be definitely assigned to any particular cause.[9] The size of the dairy enterprise, and the efficiency with which it is conducted, are thus the principal factors which determine farm earnings on most farms in Chester County and should be given first consideration in trying to improve the business of any dairy farm in this region.

TABLE 21.—*Dairy farms, classified by number of cows and dairy index*

Dairy index,[1] in dollars	Number of farms with specified numbers of dairy cows									
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows	35 to 40 cows	40 to 45 cows	45 to 50 cows	Total
−50 to 0			1							1
0 to 50	8	17	8	4	2	1				40
50 to 100	32	48	40	17	6	2			1	146
100 to 150	11	25	20	9	3		1			69
150 to 200	2	2	3	1	2	1				11
200 to 250		1	2							3
Total	53	93	74	31	13	4	1		1	270

[1] Value of milk and calves per cow less value of feed consumed, except pasturage.

TABLE 22.—*Average operator's earnings on dairy farms, with farms classified by number of cows and dairy index* [1]

Dairy index, in dollars	Average operator's earnings on dairy farms with—				
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
−50 to 0			−1,700		
0 to 50	250	110	320	1,280	300
50 to 100	590	800	970	1,340	770
100 to 150	960	1,270	1,690	1,680	1,730
150 to 200	1,200	2,150	2,870	2,300	3,750
200 to 250		2,000	2,700		

[1] These two factors alone have a multiple correlation of $R=0.73$ with operator's earnings. The relations shown in this table are therefore significant.

As is shown in Table 21, there was practically no relation between number of cows in the different herds and the efficiency with which the herd was operated.[10]

Table 22 shows the average operator's earnings in these different groups of farms. This table brings out strikingly the importance of the efficiency of operation of the dairy enterprise in determining the operator's earnings. For the farms with a dairy index below $50 per cow, it made little difference whether there were 5 cows or 25 cows in the herd; the earnings were uniformly low, with the exception of a single group. Even with a dairy index between $50 and $100 per cow the earnings were only slightly larger for the large herds than for the smaller herds. But for herds above this point in efficiency, differences in the number of cows went with increasingly large differences in earnings. Thus, in the group with dairy indexes between $100 and $150 the farmers with 20 to 25 cows earned $720 more, on the average, than did the farmers with 5 to 10 cows; in the group with indexes of $150 to $200, farmers with 20 to 25 cows earned $1,100 more than did the farmers with 5 to 10 cows.

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[9] The multiple correlation of these two factors alone with operator's earnings was $R=0.73$.

[10] The correlation is but $r=0.11\pm0.04$.

There were other differences between the farms falling in the different groups. The farms with more cows had, in general, more crop acres and more pasture. For herds of the same size but with different dairy indexes there was little difference in the other factors. In general, the farms with higher dairy indexes also had higher crop indexes,[11] but, as has already been shown, this latter factor had only a slight effect upon operator's earnings. On the other hand, the farms with higher dairy index had, in general, a little smaller acreage of crops per cow, and this would partially offset the effect of the higher yields. Altogether, the effects of factors other than the size or efficiency of the dairy upon the averages shown in Table 22 are very slight, and these averages may be considered as a satisfactory statement of the effect of these two factors on operator's earnings.[12]

RELATION OF 1922–23 PRICES TO FACTORS DETERMINING FARMERS' EARNINGS

Table 22 may be interpreted as showing that, unless each cow produced products worth at least $50 more than the feed she consumed, the farmer had left as operator's earnings less than the value of his labor. Further, the statistical study showed that it made very little difference on what size farm a given size herd was kept so far as earnings went or whether the feed was raised or purchased; earnings depended upon the size and efficiency of the dairy and not on the crop enterprises.

These results for 1922–23 should not be taken to mean that farmers in Chester County do not ordinarily add to their incomes by their crop enterprises. In 1922–23 they could buy feed for dairy cows just as cheaply as they could raise it, and they did not get a high enough price for the crops that they sold to make additional earnings by raising more crops. But it must be remembered that this year was one of very low prices for the principal crops of the section, as was shown in Table 1, and one of fairly favorable prices for the principal livestock products (Table 2). In years when crops are selling at higher relative prices it seems that the crop enterprises as well as the livestock enterprises would contribute materially to the earnings, even though they did not during the year of the survey.

FACTORS WHICH AFFECT RETURNS FROM THE DAIRY ENTERPRISE

Of all the factors which affect the earnings on dairy farms in this region, the efficiency with which the dairy enterprise is conducted has been shown to be the most important. For that reason it is worth while to examine the specific practices on different farms which were responsible for differences in this factor.

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[11] The correlation between dairy index and crop index was $r=0.23\pm0.04$.

[12] The average crop acres, pasture acres, crop index, and dairy index for dairy farms classified by dairy index and number of cows are shown in Tables 50 to 54, pages 61 and 62.

PRICE OF MILK

The index which has been used to measure the efficiency of the dairy is equally dependent upon the value of the feed used in milk production and the value of the milk sold. Hence, the production per cow, value of feed consumed per hundredweight of milk produced, and the price received for the milk per hundredweight are the three factors which determine the dairy index. The extent to which the index depends upon the price received for the milk is shown in Table 23. The milk prices shown in this table have been adjusted to a 3.7 per cent fat basis.

TABLE 23.—*Farms with dairy herds classified by the dairy index and the average price received for milk* [1]

Price of milk, in dollars, per 100 pounds	Number of farms with specified dairy indexes											Total
	−25 to 0 dollars	0 to 25 dollars	25 to 50 dollars	50 to 75 dollars	75 to 100 dollars	100 to 125 dollars	125 to 150 dollars	150 to 175 dollars	175 to 200 dollars	200 to 225 dollars	225 to 250 dollars	
1.50 to 1.70		1										1
1.70 to 1.90		1		2					1			4
1.90 to 2.10	1	1	8	3	4							17
2.10 to 2.30		9	15	26	18	3	1					72
2.30 to 2.50	1	6	25	41	36	29	5	1				144
2.50 to 2.70		1	8	16	19	14	6	1	1		1	67
2.70 to 2.90				2	4	5	2	1				14
2.90 to 3.10				1	2	1	2					6
3.10 to 3.30			1			1	1		1			4
3.30 to 3.50						1						1
3.50 to 3.70			1			2		1				4
3.70 to 3.90												
3.90 to 4.10							1		1			2
4.10 to 4.30								1	2		1	4
4.30 to 4.50									1			1
4.50 to 4.70				1					1			2
4.70 to 4.90												
4.90 to 5.10					1							1
5.10 to 5.30						1				1		2
5.30 to 5.50				1								1
Total	2	19	58	93	84	57	18	5	8	1	2	347
Average price	$2.20	$2.22	$2.36	$2.42	$2.45	$2.61	$2.70	$3.12	$3.62	$5.20	$3.40	

[1] Prices adjusted to a common basis of 3.7 per cent butterfat.

The group of farms receiving prices of $4 or more for their milk are farms producing grade A or grade AA milk, which commands a premium for high quality. This is obviously a great help in making a good showing for the dairy enterprise, but even with these high prices four herds fell below a $125 index and two below a $75 index, showing that high price alone is not sufficient to insure good returns from the dairy enterprise.

Many herds whose milk sold under $3 yet showed dairy indexes of over $100 and some even over $150, showing that by unusually efficient dairy management good returns could be obtained even when the milk was sold at a moderate price.

The market for the special grades of milk is rather limited, and for the present at least does not offer very many more men an opportunity to realize a higher price for their product. In one way, however, the price received for milk is subject to the farmers' control, and that is with regard to the seasonal distribution of production. Fluid milk nearly always commands a higher price in the winter or barn season than during the pasture season. In addition, the "basic-surplus" plan of payment used in the Philadelphia market makes an even greater difference between the actual price for summer and winter milk. The essential features of this plan are as follows (*1*):

1. Each producer shall be credited with the quantity of milk delivered by him during October, November, and December, 1922. The average production of these three months shall be known as the basic quantity.

2. During the following nine months he will receive the basic price[13] for the following percentages of this quantity of milk:

	Per cent		Per cent		Per cent
January	100	April	100	July	110
February	100	May	100	August	110
March	100	June	100	September	115

3. For additional quantities of milk above the basic quantity each farmer will receive a price based on the average price of New York 92 score, solid packed butter for that month as published by the Federal Bureau of Agricultural Economics.

a. Surplus No. 1 price.—For a quantity of milk less than or equal to the basic quantity, the average price of 92-score butter for each month plus 20 per cent will be paid.

b. Surplus No. 2 price.—For all additional milk above a quantity equal to the basic quantity the average price of 92-score butter for each of the six months, January, February, March, April, May, and June, without the 20 per cent premium, will be paid.

c. During July, August, and September all shippers shall be paid a price for surplus based on 92-score butter plus the premium of 20 per cent.

Provisions are also made for paying new dairymen who begin shipping at other than the fall basic period, counting half the shipments of the first 30 days as the "basic" quantity.

TABLE 24.—*Farms producing grade B milk classified by average price received for milk and proportion of milk produced during the winter*[1]

Proportion of milk produced during winter, in per cent.	Number of farms receiving specified average prices per 100 pounds of milk									Average price per 100 pounds
	150 to 170 cents	170 to 190 cents	190 to 210 cents	210 to 230 cents	230 to 250 cents	250 to 270 cents	270 to 290 cents	290 to 310 cents	All prices	
										Dollars
20 to 25			1	5					6	2.17
25 to 30			6	2	1		1		10	2.16
30 to 35			3	7	1	2			13	2.23
35 to 40		1	2	10	7	3			23	2.28
40 to 45	1	1	3	14	19	10	3		51	2.36
45 to 50		1	2	15	40	18		3	79	2.41
50 to 55				9	22	12	3	4	50	2.48
55 to 60				4	32	9	1		46	2.43
60 to 65				3	12	8	2		25	2.47
65 to 70				1	5	1	2		9	2.49
70 to 75					1	1	1		3	2.60
75 to 80					1				1	(2)
80 to 85										
85 to 90					2				2	(2)
Total	1	3	17	70	143	64	13	7	318	2.40

[1] Prices adjusted to a common basis of 3.7 per cent butterfat.

[2] Groups too small to compute average.

Chester County is more favorably situated for the production of winter milk than are most of the counties that supply the Philadelphia market, and for that reason further specialization in winter milk production in this area would seem profitable.

Table 24 shows to what extent the price received by men producing grade B milk varies with the proportion produced during the winter months. (The farms selling A or AA milk are omitted from this table.) The men who produced 60 per cent or more of their annual production during the winter months received on the average 20 to 40 cents more per 100 pounds for their milk than did the men who produced 40 per cent or less of the year's production during the winter season.

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[13] The basic price is determined by joint conference of producers and distributors, and in case they can not agree, by the milk arbitrator of Pennsylvania. From time to time as conditions change they meet and revise the basic price.

The seasonal distribution of production is largely determined by the time of year the cows freshen, the quality of their pasturage, and the way they are fed. The feed requirements for producing a high proportion of the milk during the winter months will be considered later.

Milk produced under such conditions that it is kept unusually clean commands a premium or "bacteria bonus" in several portions of the area surveyed, the payment of the bonus being contingent upon the milk containing below a specified minimum number of bacteria per cubic centimeter. Farmers located near a shipping station where they can take advantage of this demand for a higher quality product, can increase the price they receive with little extra expense other than that of more care in milking and with the milk utensils. (Fig. 6.)

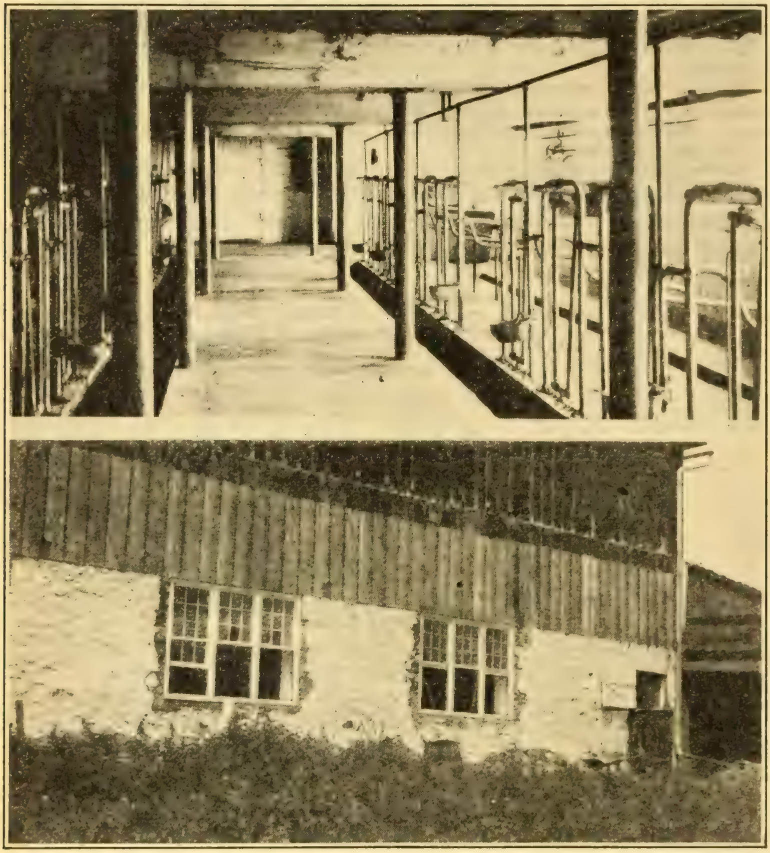

FIG. 6.—Clean milk can be produced economically, even in old barns. These two barns were brought up to date at little expense by adding cement floors and larger windows

An individual farmer can increase the price of his milk by producing a cleaner product, by producing more during the winter months, or by producing milk of higher fat test. The following discussion will bring out which of these ways yield profits.

FEED COST OF MILK

The index of dairy efficiency is just as much dependent upon the economy with which the milk is produced as it is upon the price for which the milk sells. Feed is the most important element of cost. As shown in Table 25, very few farms with feed costs above $1.25 per 100 pounds of milk had dairy indexes higher than $100. The average feed cost for farms with the lower indexes was $1.50 per hundredweight and higher, while several groups of more efficient dairies had average feed costs of less than $1 per hundredweight.

The feed cost was based upon the cost of feed purchased and the value at the farm of feed raised. No charge was included for pasturage, as no satisfactory basis was found for measuring the value of the feed furnished the cows by the pastures. In the following tables the feed cost is somewhat too low in every case, because no charge for pasture is included.

TABLE 25.—*Farms producing grade B milk classified by dairy index and feed cost per hundredweight of milk*

Dairy index in dollars	Number of farms with specified value of feed [1] consumed per hundredweight of milk produced in dollars															All farms	
	Under 0.25	0.25 to 0.50	0.50 to 0.75	0.75 to 1.00	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	Number	Average feed cost [1]
																	Dolls.
−25 to 0	----	----	----	----	----	----	----	1	----	1	----	----	----	----	----	2	2.12
0 to 25	----	----	----	----	1	1	7	8	2	1	----	1	----	----	1	22	1.91
25 to 50	----	----	----	----	9	18	18	9	----	1	----	----	----	----	----	55	1.52
50 to 75	----	----	----	6	35	29	11	1	1	1	----	----	----	----	1	85	1.32
75 to 100	1	----	4	18	28	24	3	----	2	----	----	----	----	----	----	80	1.15
100 to 125	----	----	6	22	20	1	----	----	----	----	----	1	----	----	----	50	.99
125 to 150	----	----	2	11	2	2	1	----	----	----	----	----	----	----	----	18	.97
150 to 175	----	----	1	1	2	1	----	----	----	----	----	----	----	----	----	5	1.02
175 to 200	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
200 to 225	----	----	----	1	----	----	----	----	----	----	----	----	----	----	----	1	.87
Total	1	----	13	59	97	76	40	19	5	4	----	2	----	----	2	318	1.28

[1] Exclusive of pasturage.

Individual cows differ both in the quantity of feed which they can consume, and in the efficiency with which they transform the feed into milk. If two cows are fed just the same quantity of feed, the one producing the most milk necessarily produces at the lowest unit cost.

However, many farmers in the area studied were not feeding their cows the right kind of feed or the proper quantity per cow for the most efficient production. As shown by definite statistical measurement, in this area the way the cows were fed and handled was equally important with the capacity or efficiency of the cows as a cause of variation in the feed cost of milk production. It is common knowledge that if each cow is fed just the right combination and quantity of feed for her individual ability, according to approved feeding standards, she will produce at the lowest feed cost of which she is capable; if she is fed either too much or too little, or is fed the wrong mixture, her production will be less efficient.

Table 26 shows the relation between the average production per cow and the value of the feed consumed (exclusive of pasturage) per hundredweight of milk produced. Since the cows received about the same quantity of pasturage on most of these farms, the table would not be much different if a charge for pasturage had been included. Although high production alone did not insure economical production, since other factors also were concerned, this table shows that in general there was a definite relation between the production per cow and the feed cost per hundredweight of milk, the cows with high production generally producing at lowest cost.

TABLE 26.—*Herds classified according to the average production of milk per cow and the value of feed consumed per 100 pounds of milk*

Average production, in pounds of milk per cow	Number of herds with specified value of feed consumed per 100 pounds of milk produced [1]—in dollars											
	0. 40 to 0. 60	0. 60 to 0. 80	0. 80 to 1. 00	1. 00 to 1. 20	1. 20 to 1. 40	1. 40 to 1. 60	1. 60 to 1. 80	1. 80 to 2. 00	2. 00 to 2. 20	2. 20 to 2. 40	2. 40 to 2. 60	All herds
3,000 to 4,000				5	6	3	4	4				22
4,000 to 5,000			4	11	16	12	10	7	1		1	62
5,000 to 6,000	2	8	9	25	24	18	5	4	1	1	1	98
6,000 to 7,000	2	2	19	26	19	9	5	1	2	1		86
7,000 to 8,000		4	15	21	14	1	3					58
8,000 to 9,000		4	8	6	3	2						23
9,000 to 10,000	1	2		1			1					5
10,000 to 11,000			1									1
11,000 to 12,000		1										1
Total	5	21	56	95	82	45	28	16	4	2	2	356

[1] Includes farms producing butter.

There is a definite tendency for the feed cost per 100 pounds of milk to be lower as the milk production per cow is higher. Few dairies with average production of less than 5,000 pounds per cow produced milk at less than $1 per hundredweight for feed. Yet the relation is not very close—dairies with average productions between 6,000 and 7,000 pounds ranged from less than $0.60 to over $2.20 in feed cost.[14]

The ability of some cows to produce more milk from the same quantity of feed is evidently not the most important factor determining the feed cost per 100 pounds.

Study of the records from this area showed that the quantity and quality of the feed that the cow received had a very important effect upon the feed cost of milk production, and upon the operator's earnings. Feeding a properly balanced ration was found to be very important; cows receiving rations that did not accord with recognized good feeding practice produced at high cost.

This may be illustrated by comparing the milk which would probably be produced by feeding average cows different rations, based upon the average production from different feeds shown by the farm records.

Start with a ration of 1 ton of clover hay, 1 ton of alfalfa hay and 2,000 pounds of corn for each cow in a year. That would be about 11 pounds of corn and 22 pounds of hay per cow per day for the winter season. This ration, containing only 282 pounds of true digestible protein, would have 3,344 therms of net energy. The records from the farms studied show that with such a ration and with average Chester County pasturage, cows of the average quality produced about 4,100 pounds of milk in a year.

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[14] The correlation is $r = -0.41$.

With corn worth 90 cents a bushel and bran $40 a ton, a farmer growing the feeds listed could sell part of his corn and buy bran instead. He could substitute 800 pounds of bran for 1,000 pounds of corn, and then feed 5½ pounds of corn and 4½ pounds of bran per day. His ration would then have fewer therms of net energy—2,913—but there would be 298 pounds of digestible protein. Such a ration under Chester County conditions gave an average milk yield of about 4,600 pounds, so there would be an increase of 500 pounds of milk by merely substituting bran for part of the corn, with no additional feed cost.

The ration could be still further improved by using high protein feeds in place of bran. Allowing $50 per ton for buckwheat middlings and $64 per ton for cottonseed meal, 400 pounds of middlings and 250 pounds of cottonseed meal would together cost about as much as the 800 pounds of bran. Each cow would then be getting a ton each of clover and timothy hay, 1,000 pounds of corn, and 650 pounds of the high-protein feeds yearly. This ration contains 3,012 therms of net energy, including 384 pounds of digestible protein. The average yield in Chester County from such a ration was about 5,300 pounds per cow—1,200 pounds more than from the corn ration, and 700 pounds more than from the corn-bran ration, both of which cost practically as much.

In many cases in this area men were feeding timothy who might sell the timothy and buy alfalfa, or grow alfalfa instead. The economy of this change as far as the cows are concerned can be shown by substituting alfalfa hay for the timothy in the last ration. The total ration would then contain 482 pounds of digestible protein and have a net energy value of 2,836 therms. As shown by the milk production on the farms studied, average cows fed this ration produced about 5,900 pounds per year under Chester County conditions.

The feed cost of the milk from the cows fed the ration with a protein-energy ration of 1 to 5.9 would be only $1.35 per hundredweight, as compared with $1.90 for milk from cows fed the ration with a ratio of 1 to 11.9. The feed cost per 100 pounds of milk goes down rather regularly as the protein content of the feed goes up. Table 27 illustrates the great importance of feeding the cows a properly balanced ration.

TABLE 27.—*Estimated feed cost of producing milk with various hypothetical rations*

Quantity of ration		Net energy	Digestible protein	Protein-energy ratio [1]	Value of feed [2]	Probable milk yield	Feed cost per hundredweight of milk
Grain, in pounds	Hay, in tons						
		Therms	*Pounds*		*Dollars*	*Pounds*	*Dollars*
Corn, 2,000	Clover, 1 Timothy, 1	[3] 3,344	282	1:11.9	78.12	4,110	1.90
Corn, 1,000 Bran, 800	Clover, 1 Timothy, 1	2,913	298	1:9.8	78.06	4,610	1.69
Corn, 1,000 Cottonseed meal, 250 Buckwheat middlings, 400	Clover, 1 Timothy, 1	3,012	384	1:7.8	80.06	5,315	1.51
Corn, 1,000 Cottonseed meal, 250 Buckwheat middlings, 400	Clover, 1 Alfalfa, 1	2,836	482	1:5.9	80.06	5,933	1.35

[1] Ratio of pounds of digestible true protein to therms of net energy.

[2] Corn, $0.90 per bushel, bran $40 per ton, buckwheat middlings $50 per ton. cottonseed meal $64 per ton, hay $18 per ton, pasture $10 per head per year.

[3] The therms and digestible true protein are computed from ref. (*12*), tables on pp. 749 to 751, and ref. (*2*), p. 13.

These rations are not presented as examples for use, but merely to illustrate how important intelligent feeding is, if milk is to be produced at low feed cost.[15]

It has already been pointed out that milk usually sells for more during the winter than during the rest of the year. From this one would expect that cows which produce milk the year round produce at highest feed cost.

For the conditions of Chester County, however, the reverse is true. Herds in which most of the cows freshened in the fall produced milk at less cost for feed for the average of the year, than herds in which most of the cows freshened in the spring. Table 28 shows how this worked out. The feed costs given in this table have been adjusted [16] to eliminate the effect that the kind and quality of the feed and the butterfat content of the milk have upon the feed costs, and the results therefore show only the net effect of the season of freshening on the efficiency of production.

The best dairymen in this region practice intensive winter dairying, and to some extent the differences in cost may be due to the fact that the fall-freshened herds probably included cows of good quality, handled by skilled dairymen; but from Table 28 it would certainly be safe to say that in this region farmers can produce a uniform flow of milk throughout the year without increasing their feed cost per hundred pounds and are therefore in good position to take advantage of the higher price paid for winter milk.

TABLE 28.—*Relation of the season of year the cows freshen to the feed cost of milk production*

Proportion of cows freshening in the fall, in per cent	Herds in group	Value of feed [1] consumed per 100 pounds of milk produced
	Number	*Dollars*
None	59	1. 34
20 to 30	48	1. 32
50 to 60	31	1. 24
70 to 80	24	1. 19
90 to 100	16	1. 19

[1] Exclusive of pasturage.

Table 29 shows how closely the time of year the cows freshen is related to the seasonal distribution of milk production throughout the year. On the farms where only one-quarter of the milk was produced during the barn season, less than 10 per cent of the cows freshened in the fall; on the farms where three-quarters of the milk was produced during the barn season, over 75 per cent of the cows freshened in the fall.

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[15] References (*14*) and (*15*) give detailed information on the subject of the proper feeding for dairy cows.

[16] By multiple correlation. See p. 59.

TABLE 29.—*Relation of milk produced during the winter season to the season the cows freshen*

Percentage of annual production during winter season	Percentage of herd freshening in—				
	Fall months	Winter months	Spring months	Summer months	Total for year
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
20 to 29.5	9.3	25.3	55.4	10.0	100
30 to 39.5	21.7	30.2	34.1	14.0	100
40 to 49.5	34.2	24.6	23.9	17.3	100
50 to 59.5	49.6	22.9	13.6	13.9	100
60 to 69.5	67.9	16.2	5.9	10.0	100
70 to 79.5	75.4	21.9	0.0	2.7	100

Part of the difference in the prices that different men received for their milk was due to the premium that they received for the higher fat-content of their milk. Whether it pays to produce this higher-test milk depends upon the extra feed cost of the richer milk.

Table 30 shows the average relation of the test of the milk to the feed cost per 100 pounds, after adjusting the feed cost to eliminate the effect of the quantity of feed which the cows received and its protein content, and the season of year the cows freshened.

TABLE 30.—*Relation of the butterfat test of the milk to the feed cost of milk production*

Per cent of butterfat [1]	Herds in group	Value of feed consumed [2] per 100 pounds of milk produced
	Number	*Dollars*
3.3	18	1.17
3.5	56	1.22
3.7	44	1.26
3.9	25	1.34
4.1	12	1.44
4.3	7	1.49

[1] The simple average of the 12 monthly tests.
[2] Exclusive of pasturage.

The farmers producing 3.7 per cent milk fed 9 cents more feed for each 100 pounds of milk produced than did the farmers producing 3.3 per cent milk. At the premium of 4 cents per "point," they received 16 cents more per 100 pounds, so with the feed prices of 1922–23 it paid them to produce the richer milk. The men producing 3.9 per cent milk fed 8 cents more feed per 100 pounds than did those producing 3.7 per cent milk, and it was worth just 8 cents more. But from 3.9 per cent to 4.1 per cent the extra feed cost of producing milk of higher fat test was more than the extra value of the milk, while above 4.1 per cent there were too few records for significant results. This would indicate that, with the kind of cows used in this area, dairymen who produce grade B milk attain the greatest profits by producing milk of about 3.7 to 3.9 per cent fat, and that using cows producing milk with more or less fat than this tends to reduce the net returns slightly, with the differential for butterfat the same as it was in 1922. This does not apply, of course, to men who produce rich milk for a special market, such as the grade A or grade AA producers.

Every dairyman recognizes the fact that individual cows vary widely in their ability to produce economically and efficiently. Inherent ability of cows to produce large quantities, however, is one factor that can not be measured directly. To some extent it may be reflected in the value which is placed on a cow. Differences in the average value of the cows in the different herds, as estimated by the farmers, may hence be used as a very rough measure of the differences in their quality. Table 31 shows the average feed cost per 100 pounds according to the average values of the cows, adjusted to eliminate the effect of the factors affecting feed cost which have already been discussed.

TABLE 31.—*Average feed cost per 100 pounds of milk, according to the average value of the cows*

Average value per cow, in dollars	Herds in group	Value of feed consumed [1] per 100 pounds of milk produced
	Number	*Dollars*
Below 50	4	1.37
60 to 70	38	1.31
80 to 90	66	1.26
100 to 110	67	1.23
120 to 130	13	1.22
Over 150	14	1.22

[1] Exclusive of pasturage.

For cows valued up to $100 the feed cost decreased very markedly as the value of the cows increased; cows valued at $125 produced at slightly lower cost than those valued at $100, but cows valued at more than $150 were no more efficient than those valued at $125. This does not necessarily mean that the $150 cows were actually worth no more than the $125 cows. They may have produced calves worth enough more to justify the value placed on the cows. It does mean, however, that as milk producers their value was no higher than that of $125 cows. Even as imperfectly shown by their values, this table brings out the importance of having good cows if one is to make the greatest profits from dairying.

Weeding out inefficient producers is as effective a way of improving the efficiency of a grade herd as is buying purebred stock. In fact, continual weeding is necessary with purebreds as well as with grades. Keeping some record of the production of the individual cows is a great help in picking out the poor cows. Weighing and recording the milk from each cow, if only once each week or month, is well worth the time it takes.

SUMMARY

This examination of the factors affecting the returns from the dairy enterprise has shown that the price at which the milk is sold and the efficiency with which it is produced together very largely determine the profits realized from a dairy of a given size. Even where no better market is available, many men can raise the average price they receive by producing a larger proportion of the milk during the winter season and by closer attention to cleanliness. But the greatest changes can be made in lowering the feed cost of the milk.

Improving the quality of the cows, paying more attention to feeding each cow just the right quantity of feed, and better balancing of rations are the important ways by which a farmer can increase the efficiency of his dairy.

Efficient cows, comfortably housed, and intelligently fed and cared for, constitute the most important essential to profitable dairy farming.

PLACE OF THE MUSHROOM ENTERPRISE ON DAIRY FARMS

The 25 farms which were classed as mushroom-dairy farms varied in size from less than 30 to over 120 crop acres, and from less than 5 cows to over 25. As shown in Table 32, the larger the farm the more cows were kept. On the smaller dairy farms, with less than 60 crop-acres, not so many cows were kept as on straight dairy farms of the same size, while on the larger mushroom-dairy farms about as many cows were kept as on dairy farms with the same crop acreage. (Table 6, p. 10.)

TABLE 32.—*Mushroom-dairy farms classified according to the number of crop acres and the number of cows kept*

Number of cows	Number of farms with specified acreage in crops								All sizes
	16 to 30 acres	31 to 45 acres	46 to 60 acres	61 to 75 acres	76 to 90 acres	91 to 105 acres	106 to 120 acres	121 to 135 acres	
5 or less	2	1	1					1	5
6 to 10	1	1	5						7
11 to 15				2	1				3
16 to 20				2	1	1			4
21 to 25				1	1		2		4
26 to 30				2					2
Total	3	2	6	7	3	1	2	1	25

In only two size groups, those including the farms of from 46 to 60 and from 61 to 75 crop-acres, are there enough mushroom-dairy farms to make the averages at all significant. However, nearly half of the dairy farms fall in these two groups and it is therefore worth comparing briefly the average organization of the dairy and mushroom-dairy farms of these sizes. Table 33 gives this comparison.

TABLE 33.—*Comparative organization of dairy and mushroom-dairy farms of the same size*

Item	Farms 40 to 60 crop acres		Farms 61 to 75 crop acres	
	Dairy	Mushroom-dairy	Dairy	Mushroom-dairy
Number of farms	76	6	48	7
Acreage in farms	99	88	112	119
Acreage in pasture	24	20	23	26
Acreage in crops	53	52	67	67
Acreage in:				
Corn for grain	11.4	10.0	11.8	14.1
Corn for silage or cut green	2.9	3.7	3.9	4.6
Small grains	13.1	12.6	16.6	12.5
Hay other than alfalfa	17.9	16.5	24.7	23.9
Alfalfa	4.0	4.4	5.7	9.3
Livestock:				
Cows head	14.7	11.8	14.9	20.2
Other dairy cattle animal units	1.4	1.1	2.1	3.0
Beef cattle	.1		.3	
Hogs	1.6	2.2	2.4	1.8
Chickens	103	117	106	123
Work stock	4.2	4.2	4.1	4.5

The crops grown are just about the same on both the mushroom and mushroom-dairy farms, although the acreage of silage and of alfalfa was slightly higher on the latter, and the acreage of small grains slightly less. For these particular farms the livestock was just about the same for both types, the mushroom-dairy farms of one group averaging less cows and of the other group more cows than the corresponding groups of dairy farms. The mushroom-dairy farms did not use any more workstock than the dairy farms in one group, and only slightly more in the other.

As shown in Table 34, except for mushrooms the receipts were about the same on both types of farms, the mushroom-dairy farms selling somewhat more crops and less miscellaneous livestock products than the dairy farms of the same size. The sale of dairy products varied with the number of cows, but in both groups the value of the product per cow was higher for the mushroom-dairy farms than for the dairy farms. This indicates that the men operating the mushroom-dairy farms were somewhat more efficient farmers than those operating plain dairy farms of the same size, and for that reason part of any extra profit they made may be due to this ability of the farmers rather than merely to the enterprise conducted.

TABLE 34.—*Sources of cash income on dairy and mushroom-dairy farms of the same size*

Item	Farms 46 to 60 crop acres		Farms 61 to 75 crop acres	
	Dairy	Mushroom-dairy	Dairy	Mushroom-dairy
Number of farms	76	6	48	7
Cash receipts from:	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Crops	520	689	707	856
Mushrooms		832		3, 917
Dairy cattle	294	211	333	636
Dairy products	2, 031	1, 706	2, 150	3, 106
Poultry	282	286	291	284
Other livestock and miscellaneous	66	32	97	
Total	3, 193	3, 756	3, 578	8, 799
Dairy products per cow	138	145	144	154

TABLE 35.—*Financial results for dairy and mushroom-dairy farms of the same size*

Item	Farms 46 to 60 crop acres		Farms 61 to 75 crop acres	
	Dairy	Mushroom-dairy	Dairy	Mushroom-dairy
	Dollars	*Dollars*	*Dollars*	*Dollars*
Products sold	3, 195	4, 949	3, 586	10, 628
Farm products used by family	277	286	252	340
Gains in inventory	75	207	192	178
Total value of products	3, 547	5, 442	4, 030	10, 790
Charges against product:				
Cash expenses, except land and interest	1, 726	3, 273	2, 121	4, 780
Value of family labor	328	440	213	421
Charge for use of real estate and capital	524	566	649	931
Total charges	2, 578	4, 279	2, 983	6, 132
Operator's earnings	969	1, 163	1, 047	4, 658

Table 35 shows the financial results for the two types of farms. The average operator's earnings for the mushroom-dairy farms of 46 to 60 crop acres were only about $200 higher than for the dairy farms of the same size. In the other group the earnings on the mushroom-dairy farms were much greater than on the dairy farms, because of the presence of two exceptionally large and successful farms. Figure 7 shows the differences in the distribution of operator's earnings in these two groups.

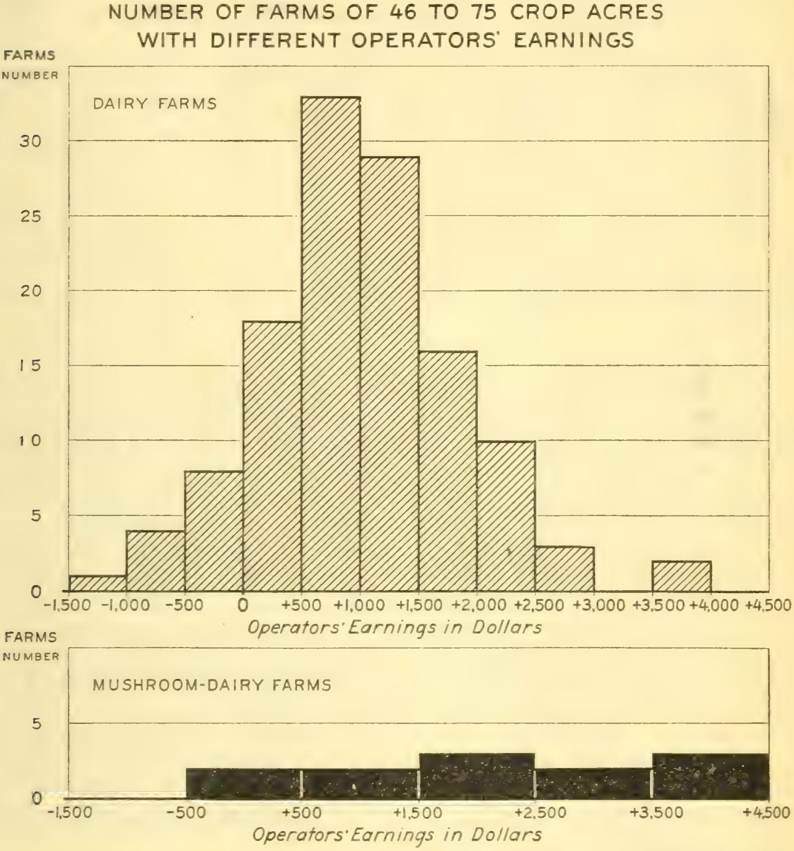

FIG. 7.—Most of the men operating mushroom-dairy farms of 46 to 75 crop acres made larger earnings than the average from dairy farms of the same size

Most of the mushroom-dairy farmers had larger earnings than most of the dairy farmers but the difference between these typical men was not as large as between the exceptional men. It would appear that growing mushrooms offers the average man an opportunity to increase his receipts to some extent, and the man of exceptional ability an opportunity to make large profits.

Favorable location of the farm is one of the principal prerequisites for profits from mushroom production. Handling the very large quantities of manure from freight cars to the farm is a much more expensive matter for a man located miles from a freight siding than for one who has a siding on his own farm. Mushroom production also requires a heavy investment in buildings and large expenditures for spawn, labor, and manure. Only a farmer with good financial resources can go into mushroom production on a large scale.

TABLE 36.—*Direct expenses and receipts for the mushroom enterprise*

Item	Unit	Mushroom-dairy farms			Other mushroom farms		
		Physical units	Value	Value per 100 square feet of beds	Physical units	Value	Value per 100 square feet of beds
Direct expense items:			*Dollars*	*Dollars*		*Dollars*	*Dollars*
Manure purchased	Tons	168	738	6.18	250	1,046	5.69
Spawn	Bottles	354	278	2.33	470	371	2.02
Baskets	Hundreds	40	174	1.46	56	266	1.45
Coal	Tons	15.9	151	1.26	28.1	264	1.44
Freight			51	.43		142	.77
Trucking			14	.12		38	.21
Commission			29	.24		37	.20
Labor			167	1.40		477	2.59
Miscellaneous			10	.08		10	.05
Total direct expense			1,612	13.50		2,651	14.42
Sales:							
Mushrooms	Boxes	3,690	3,750	31.40	5,353	5,091	27.70
Surplus above direct expense			2,138	17.90		2,440	13.28
Area in beds	Square feet	11,942			18,381		
Yield per square foot	Pounds	0.93			0.87		

Table 36 shows the average quantities of different materials used in mushroom production upon both the straight mushroom farms and the mushroom-dairy farms. The mushroom enterprise was smaller on the mushroom-dairy farms as a rule, and the values of the various items are therefore expressed per 100 square feet of bed, so that expenditures on the two types of operation can be compared.

It is probable that the differences in expenditures per 100 square feet of beds for such items as manure, spawn, coal, freight, and trucking are not of much significance, as they are due more to the rather small number of cases included in each average than to actual differences in the efficiency of operation. For labor, however, the difference is significant, the extra labor on the straight mushroom farms averaging nearly twice as much (per 100 square feet) as on the mushroom-dairy farms. This indicates what is probably the most significant economy in combining mushroom production with dairy farming—the possibility of utilizing regular farm labor in working on the mushrooms at a period when no other profitable disposition of the labor is available.

The surplus per 100 square feet of beds, as shown in Table 36, was decidedly larger for the mushroom-dairy farms than for the other mushroom farms. This was owing in large part to the heavier yield on the mushroom-dairy farms and to the higher price obtained. The higher yield, though possibly owing in part to the heavier use of manure and spawn on the mushroom-dairy farms, was probably more a reflection of the fact, previously mentioned, that in general the dairy farmers who were also growing mushrooms were exceptionally skillful farmers. This table shows that their mushroom enterprises as well as their dairy operations were more efficient than the average. An energetic and intelligent man can combine a mushroom enterprise with his dairy farm and operate both of them efficiently.

SUMMARY

The dairy enterprise is the central point in the organization of most Chester County farms. Although under special conditions other products, such as mushrooms, poultry, or crops, may become equally important sources of cash income, for most farmers dairy farming is most profitable. Unusually energetic and capable dairymen, however, can add to their returns by combining mushroom production with dairying.

Under the conditions of the year of the survey, dairy and poultry products were relatively more profitable as compared with crops than they have usually been. For this reason the conclusion that during that one year only the number of cows and not the acres of crops affected operator's earnings, should not be taken to mean that under usual conditions crops do not contribute to farm earnings. With more favorable prices than prevailed in 1922 and 1923, the acreage of crops would be more important in relation to net returns.

The efficiency with which the dairy enterprise was conducted was the most important factor in causing differences in earnings. A large part of the variation in dairy efficiency was due to the intelligence and care that farmers used in selecting, feeding, and caring for their cows. Intelligent and skillful dairy management is essential to success on most Chester County farms.

Some individual specialized mushroom farms made large earnings, and the operator's earnings on these farms averaged about $650 above the earnings on dairy farms. With the possible extent of the demand for mushrooms still to be determined, and with supplies of manure suitable for mushrooms tending to become limited, no statement can be made as to how long mushroom production will prove more profitable than milk production.

METHODS OF MEASURING COMPLEX FACTORS

CHARGE FOR USE OF LAND

The "operator earnings" method of computing returns to the farmer depends upon allocating to all factors in production except the operator what those factors are worth as shown by the going market rate, leaving the operator as the residual claimant.

The differences between the charges made for the use of land under the operator's earnings method and the charge which would have been made on the labor income method, are shown in Table 37.

The labor income method of obtaining the charge for the use of land varies in three particulars from the general principle of valuing each factor at what it is worth "on the market:" (1) All that the land contributed to the annual product is the use of that land for one year; (2) a considerable part of the value of the farm represents a dwelling which is not directly utilized in the production of agricultural products; and (3) the current mortgage rate of interest is not a good measure of the percentage return which farm land should be expected to yield. As H. C. Taylor has worked out on a theoretical basis (*18*, pp. 106–107), later proved by a study of the facts in the case (*4*, pp. 28–46), the general expectation of continuing increases in the value of land tends to hold its price at a higher level than is justified by its current earning power. That is, the current interest obtained from investments in land which is expected to increase in value can not be so high as the interest obtained from mortgage investments, on which there is no possibility of additional return due to later increases in value.

TABLE 37.—*Charges for use of land and buildings, on the "labor income" basis and on the "operator's earnings" basis*

Items	Type of farm				
	Dairy	Small dairy	Mush-room-dairy	Mush-room	Crop
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Real estate value	12, 650	10, 189	16, 097	13, 842	14, 389
Taxes	164	124	202	130	156
Insurance on buildings	42	29	77	66	36
Building repair and estimated depreciation	343	262	407	274	294
5 per cent on real estate investment	632	509	805	692	719
Total	1, 181	924	1, 491	1, 162	1, 205
Charge made by "operator's earnings" method [1]	377	280	492	381	443
Difference	804	644	999	781	762

[1] At 4 per cent on value of real estate used in farm business, which covers taxes, insurance, and repairs as well as "economic rent."

A much closer approximation to what the land is really contributing to the value of the product can be obtained by using annual rents. At a time when conditions are fairly stable, the average net return to landlords furnishes an actual measurement of payment for the use of land, in a market where merely the current uses, and not future increments, are valued. Where the taxes, insurance, and building upkeep are paid by the owner, the gross rental (under fairly stable conditions) is the market price for the annual use of the farm, regardless of what part of that payment goes to taxes, what part to insurance and building upkeep, and what part to net return to the landlord. For the purposes for which the charge for the use of land is to be made in farm-management studies, therefore, a charge equal to the current gross rent in the area, ignoring other land costs, will be sufficient to serve as a market estimate of the value of the use of the farm for the year.

The actual level of rent prevailing may be most accurately obtained by considering cash rents, because with share forms of rent the landlord is really a partner in the business, in many cases furnishing a good part of the management needed in organizing and operating the farm as well as furnishing livestock, sometimes equipment, and sharing in much of the expense as well as the receipts. Cash rent, on the other hand, is a much better approximation to the price of the use of the farm, unobscured by other items.

As shown by the entries on the census farm schedules in 1920, the average cash rent paid in Chester County at that time was equal to 3.9 per cent on the value of the farms (*4*). This was merely the cash rent reported on the schedules, and did not show what expenses the landlord had to pay out of his cash rent, nor what land taxes the tenant paid in addition.

The farm-survey schedules obtained in 1923 gave data for a check on this average rate of cash rent, and showed the distribution of taxes as between landlords and tenants. Excluding the farms rented from fathers or other near relatives, 15 cash-rented farms were included in the survey. The average values, rents, and expenses on these farms are given in Table 38.

TABLE 38.—*Average values and rents on cash rented farms, Chester County, Pa., 1922–23*

Item	Average per farm	Item	Average per farm
	Dollars		*Dollars*
Farm value, 1922	14,554	Taxes on land	41
Working capital, 1922	3,555	Taxes paid by landlord	132
Cash rent paid	547	Insurance paid by landlord	32
Taxes paid by tenant, total	81	Total rent paid by tenant in cash and taxes	588
Taxes on stock and equipment (estimated)	40	Total rent, in per cent of farm value	4.04

As shown in Table 38, the gross rent paid by the tenant, including land taxes in the cases where they were paid by tenants, came to little over 4 per cent on the value of the farm. Deducting from the average cash rent of $547 received by landlords their average payment of $164 for taxes and insurance, the net rent left was but $383, or but 2.6 per cent on investment. Even this is not a true net rent, because repairs and depreciation on the buildings would have to be paid out of this.

Although it is true that so few farms are rented for cash in the area surveyed that it may be questioned if there is a very active market for "the use of farms," still the fact that the average rate of rent from these few farms agrees so closely with the average rate as shown for the whole county by the census would indicate that 4 per cent is a fairly reliable estimate of the average gross rent. This is therefore used to represent "the contribution of land" to the product of Chester County farms. This actual market rate is evidently much lower than the land charge on the "labor income basis," which included taxes, insurance, repairs, and depreciation, plus a 5 per cent interest charge. As shown in Table 37, this would have made a gross rental of about 9 per cent, or more than twice what the same service actually sold for "on the market."

This conclusion does not indicate that Chester County farms are over-valued, but merely that their value does not rest entirely upon their current annual return from agricultural production. Only that part of their value which does rest upon such return can fairly be considered in making a deduction from a farmer's return to cover the use of land in agricultural production, and that is what has been done in this particular case.

This "appeal to the market" satisfies two of the three questions previously raised as to the method of evaluating the use of land. The question as to the value of the dwelling houses remains to be considered.

There are but two logical alternatives: Either include the value of the rent of the dwelling as part of the farm production to offset the charges connected with it, or eliminate from the farm expenses those items due to the dwelling, and make no attempt to estimate the value of its use in the receipts. (One additional reason why the "labor income" figure has been a rather unsatisfactory measure of farmers' earnings is that all the charges in connection with the dwelling were included on the debit side, without crediting the value of its use on the other.)

Theoretically, there is no more reason why the farmer's dwelling house should be counted a part of the farming business than for the banker's house to be counted a part of banking or the merchant's house a part of marketing—it has been so included previously largely as a matter of accounting convenience. For this reason the charges for the use of land in the study reported in this bulletin have been made as if the farmer's dwelling were on one side of a road and his farm and outbuildings on the other, with an entirely separate set of accounts for his farm business and his domestic affairs. The use of the farm dwelling has thus been excluded from the statement of "farm products," and the expenses connected with it have likewise been excluded from "farm expenses." [17]

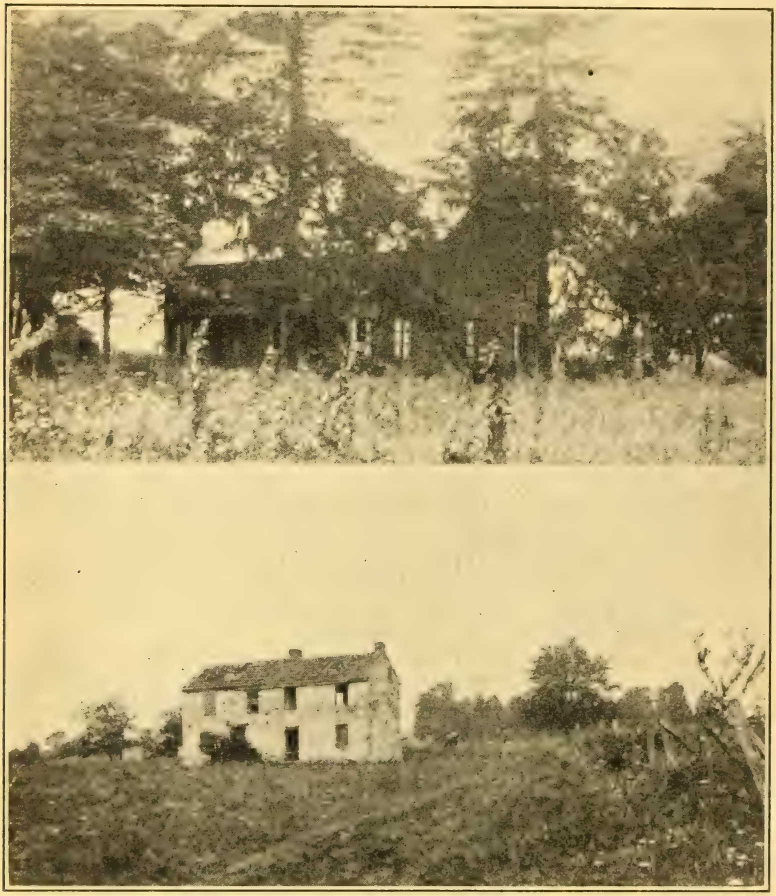

FIG. 8.—A vacant dwelling and an abandoned tenant house, both of solid stone construction. With larger farms and more machinery, not so many houses are needed as in 1800

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[17] For a fuller statement of the theoretical basis of the "operator's earnings" method of measuring farmers' incomes for farm management studies, see (*9*). For statistical comparison of the adequacy of the "operator's earnings" and "labor income" methods, see (7).

This procedure, however, has many accounting difficulties of its own, particularly in an old area like Chester County. This region was settled before the Revolutionary War, and the size of the farms and the number of buildings were largely determined long before the extensive development in farm machinery in the second half of the last century. At present, corn planters and cultivators, wheat drills and harvesters, hay mowers and rakes are used on practically every farm, and many farms are also using such more recent machinery as hay-loaders, hay forks and slings, milking machines, and even tractors and gang plows. With the crops grown still largely the same as those grown when the first census was taken in 1850, one man to-day can handle much more land than he could handle before the introduction of modern machinery. This has resulted in a decided tendency to increase the size of farms. As a natural consequence of the gradual consolidation of farms, there are now more dwellings in the area than are needed to house the farm workers. With this surplus of buildings, farms in many instances can be bought for less than the replacement value of the buildings alone (fig. 8).

Recognizing this difficulty, no attempt was made at the time of making the survey, to divide the farm value into the value of the land, the value of the dwelling, and the value of the other buildings. To have attempted to get the separate values from the farmers would merely have been asking them to estimate something that they did not know. Had the value of the dwelling been obtained on this basis there would have been no way of separating the value of the dwelling from the value of the rest of the farm, as both figures would have been largely artificial; and so no separation could have been made of farm and dwelling expenses.

Instead, each farmer was asked to estimate the actual sales value of the farm as a whole and then to estimate the fair value of the buildings separately, considering the fire insurance he carried on them and the replacement cost. In making this second estimate he was told not to consider the value of the whole farm, but to estimate the building values solely as a separate question. The average values obtained by this process are shown in Table 39.

TABLE 39.—*Average value per farm of real estate and buildings*

Item	Units	Farms reporting mushrooms [1]	Other farms
Number of farms [2]	Number	54	368
Size of farms	Acres	85.3	104.1
All real estate:			
Dwelling house	Dollars	10,896	6,020
Dairy barns	Dollars	5,237	4,866
Other buildings	Dollars	16,185	1,106
Total buildings, as reported	Dollars	32,318	11,992
Total all real estate	Dollars	29,795	12,932

[1] This group includes two off-type farms which were later discarded as well as mushroom farms.

[2] This table includes several farms which were discarded in subsequent tabulations.

It is evident that the "values" obtained by these questions are more than the buildings are really "worth," if by "worth" we mean what the buildings add to the market value of the farm. If this were a territory where land was frequently sold without the buildings, that would give some basis for appraising separately the market values of land and of buildings, but such sales are so rare and unrepresentative that they give no adequate basis.

Fortunately, statistical methods are available for determining what part of the farm value is represented by the buildings, and what part is represented by the land, even where neither can be directly measured separately. These methods have been applied successfully in other areas (*4*, *11*). By the analysis of these farm records by this same method, as described in detail in the following section, it was possible to determine what part of the total farm value was contributed by the dwelling house, and what part was contributed by the land and farm buildings. The distribution, previously shown in Table 17, is as follows:

Group of farms	Total real estate value	Part due to dwelling value	Part due to real estate used in farm production
	Dollars	*Dollars*	*Dollars*
Dairy farms	12, 650	3, 228	9, 422
Small dairy	10, 189	3, 178	7, 011
Mushroom dairy	16, 097	3, 797	12, 300
Mushroom	13, 842	4, 326	9, 516
Crop farms	14, 389	3, 310	11, 079

On the assumption that the rental would be at the same rate on both the part of the value represented by the dwelling and on the part of the farm used in production, the 4 per cent gross rate was applied to the values shown in the last column—the sales value of the farm less that part of its value due to the dwelling—to obtain the total charge to be made for the use of land and equipment. If anything, this assumption errs in the direction of making the charge to the farm business too high, as repairs, depreciation, and insurance borne by the landlord, are certainly relatively heavier expenses on the dwelling than on the other buildings and farm land lumped together. In a region where cash renting was a common practice, it would be possible by statistical analysis to measure the relative importance of dwelling and productive plant in determining the rent paid, and to determine what rates should be applied to each individually. In the present survey, however, not enough cash rent records were available for such a study, nor would the results obtained have been of enough importance to justify making it. In other areas, where land values are higher and the deduction for the use of land makes up a larger part of the charges than it does in this area, such a further study might be well worth while. The assumption as stated, however, was used as a sufficiently accurate working hypothesis for the present case.

The final charge for the use of land, as shown in Table 37, page 40, was therefore computed at 4 per cent of the "value of the real estate used in the farm business." As shown in this table, the average charge for the use of land in the different groups on this basis varied from about $600 to $1,000 less than it would have been if made on the basis used in "labor income" studies. For individual farms, of course, the variation between the two would be much wider. This is one reason why the "operator's earnings" figure used in this bulletin as a measure of farmers' success varies widely from the "labor income" figure which has been used in other studies. The fact, brought out elsewhere (7), that the figure for the operator's earnings does tally with variations in farm efficiency much more closely than does the labor income figure, would seem to offer at least some measure of empirical proof that the reasoning upon which the new measure is based is sound and useful.

A correlation study of the relation of farm buildings to the value of the farm was made for the specific purpose of determining what part of the "value" of the farm dwelling, as estimated by the farmers in the way described, was represented in the value of the farm. In a region where land was being brought under cultivation and new houses were being constantly erected, a $6,000 house should add $6,000 or even more to the value of the farm upon which it was built. In a region where farms were being abandoned and the population was diminishing rapidly, a $6,000 house might add nothing to the value of the farm upon which it was built. Chester County lies between these two extremes; the problem is to find just what part of the dwelling values (on the average) are added to the value of the land on which they stand.

The simplest way to approach this problem would be to pick out farms of the same size, fertility, and with farm buildings other than the dwelling of the same value, but with dwellings of different values upon them. Then, if enough such very similar farms could be found, comparing the differences in the values of the farms with the differences in the estimated values of the dwellings would show the relation of the latter to the former, for the particular size and type of farm considered. This would be a fairly accurate result, because the method of grouping would hold constant the other factors such as size of farm, fertility of soil, and value of the dwelling, which otherwise might influence the farm value and so obscure the relation of dwelling value to farm value.

In practice, however, there are so many different causes affecting farm value that it is impracticable to use this method. With the limited number of records it would be almost impossible to pick out enough farms exactly or even approximately alike in all particulars except value of the dwelling and value of the farm to give reliable averages. And even could such a group be chosen, the results from that group would be applicable only to farms of the particular size, fertility, etc., included in the group, and would not apply to other farms in the area.

The statistical method of multiple correlation furnishes another way of getting the same result, not merely for a particular group of farms but as an average for all the farms in the area. By using this method it is possible to determine exactly the average relation between the estimated value of the dwelling and the value of the farm, holding constant (by mathematical means) all the other factors included which may influence the farm value. This mathematical process may be thought of as equivalent to making all possible groupings of the kind suggested in the two previous paragraphs, noting the results of each grouping, and then making a weighted average of the relation between dwelling value and farm value as found for each grouping.

As a by-product of this analysis, too, we have not only the average relation of dwelling value to farm value, but also the average relation of every other factor considered to the value of the farm.

As the first step toward the multiple correlation analysis, the different factors to be considered must be decided upon. Planning such an analysis after the basic records have been obtained, instead of before, the analysis is necessarily limited to the data already obtained. Within this limit, the following items were selected as likely to affect the farm value:

Value of the dwelling (and tenant houses, if any).
Value of the dairy barn, silo, and milk house.
Value of other buildings.
Fertility of the soil (as shown by a crop index).
Percentage of the farm area tillable.
Percentage of the farm area level.
Type of road upon which the farm fronts.
Distance to the nearest town.

The crop index was computed by the usual methods, using only the yields of the most significant crops—corn, wheat, clover, and alfalfa—in making the computation.

The type of road was designated according to a "code," as follows: (1) "State" road, concrete or asphalt; (2) macadam road; (3) broken stone, gravel, or slag, water-bound; and (4) dirt road.

The correlation might have been made by adding the number of acres of land as a factor and then correlating all these factors directly with the total value of the farm. This would necessarily have given a very high correlation, since obviously the larger the farm the greater the value. By reducing all the items to terms of value per acre this difficulty can be avoided. Correlating the value per acre of the different classes of buildings, and the other items, with the value per acre of the farm should give a much more delicate measurement of the effect of the different factors upon farm values, since, other factors being equal, the value of the land should not vary with the size of the farm.[18] This procedure had been found to give good results in similar previous work (*11*) and was therefore adopted for this analysis.

The factors used in the initial correlation study were therefore stated as follows:

A. Value per acre of the dwelling (and tenant house).
B. Value per acre of the dairy buildings.
C. Value per acre of other buildings.
D. Crop index.
E. Percentage of the farm area tillable.
F. Percentage of the farm area level.
G. Code for type of road.
H. Distance to town.
I. Value of the farm per acre.

Correlating the eight other factors with land value,[19] a multiple correlation of $R_{i \cdot ab \cdot \cdot h} = 0.98$ was obtained, using all of the 422 records obtained in the survey. This indicated that the eight factors measured over 95 per cent of all the causes which affected the acre value of these farms.

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[18] This last assumption may be open to question. As will be pointed out later, the analysis could be so organized as to test it out and determine whether it is correct, instead of making it to a large extent implicit in all the subsequent analyses.

[19] Correlation analyses such as this, involving many variables, may be accomplished most easily by using the methods outlined in (*19*).

The relation between the different factors and the farm value per acre was as follows:

On the average, for each increase of:	Farm value per acre showed an increase of
10 dollars in dwelling value per acre	$9.75
10 dollars in dairy building value per acre	—.10
10 dollars in other building value per acre	9.29
10 units in crop index	5.60
10 per cent in proportion of farm tillable	3.96
10 per cent in proportion of farm level	2.47
One unit in road type index	−6.73
One mile in distance to town	−5.47

With the single exception of the value of the dairy buildings, these results seem fairly reasonable, although they would indicate that the dwelling and farm buildings, other than the dairy buildings, added a larger part of their value to the farm value than the previous study would have led one to expect.

The relative importance of the different factors in determining farm values per acre in this area, as shown by their coefficients of determination (*16, footnote 1, p. 42*), are as follows:

Factor:	Per cent
A. Dwelling value	30.9
B. Dairy buildings value	—.3
C. Other buildings value	64.4
D. Crop index	.04
E. Percentage of area tillable	—.4
F. Percentage of area level	.4
G. Type of road	.4
H. Distance to town	.5
Total	95.9

According to this statement, differences in the acre value of the farms were owing almost entirely to differences in the acre value of "other" buildings and the dwelling, and only in very small part to differences in the dairy barns or other factors. On the face of it, this seems an unreasonable conclusion, and indicates that there must be something seriously wrong with the way the problem was handled or the way the factors were "set up" for statistical examination.

Closer examination of the original data showed this indication to be correct. Many of the farms growing mushrooms had only a very few acres of land, yet had expensive dwellings and large investments in mushroom houses. When these high values were stated as values per acre, they gave acre values for the farm, the dwelling, and "other" buildings—principally mushroom houses—very much higher than the corresponding values for the general run of farms of the region. These extreme observations covered only a small portion of the total number of cases, yet by reason of their extreme variation were sufficient to overshadow completely the relations of the other factors on the more typical farms.[20] Table 40, which shows the frequency distribution of several items for all the 422 farms included in this first analysis, and then shows the distribution of the same items for the 368 farms remaining after excluding the farms growing mushrooms from the tabulation, illustrates the difficulty.

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[20] For a fuller discussion of the effect of extreme items of this sort in correlation analysis, see (*13*), pp. 406–408.

TABLE 40.—*Frequency distributions of farms according to the values per acre of several items, both including and excluding mushroom farms*

Value in dollars per acre	All farms classified by value per acre of—			All farms except mushroom farms classified by value per acre of—		
	Land I	Dwelling A	"Other" buildings C	Land I	Dwelling A	"Other" buildings C
0 to 50		195	391		183	367
50 to 100	118	173	12	113	151	1
100 to 150	190	33	5	171	25	
150 to 200	62	11		55	7	
200 to 250	27	3	3	21	1	
250 to 300	6	1	3	5		
300 to 350	5	2	1	3	1	
350 to 400	1	1	3			
400 to 450	3	1	1			
450 to 500	1					
500 to 750	5	1				
750 to 1,000						
1,000 to 1,500	1	1	1			
1,500 to 2,000	1		1			
2,000 to 2,500	1		1			
2,500 to 3,000	1					

Table 40 shows how much the inclusion of the mushroom farms distorted the picture. Although the highest value per acre reported on any of the other farms was under $350 per acre, some of the mushroom farms ran over $2,000 per acre. And even more striking, although only one of the other farms showed values for buildings other than dwelling or dairy running above $50 per acre, on several of the mushroom farms values up to $2,500 per acre were reported. For this reason it was decided to omit the farms reporting mushrooms from the balance of the tabulation and analyze the factors responsible for land values separately for the other 368 farms.

Estimating value of the farm per acre (I) for these 368 farms on the basis of the net regressions shown on page 47, the correlation between the estimated and observed values was found to be but $R = 0.64$. This showed conclusively that the relation of these eight factors to farm value, as determined by the first correlation, was a very poor statement of the actual relations when the farms with mushroom houses were left out of consideration.

The analysis for these 368 farms was carried through to show not merely the average relation of the value of the dwelling to the value of the farm but also the contribution of the dwelling value to the farm value for dwellings of various values on farms of various sizes, as it was found that the more expensive the dwelling the smaller the proportion of its value which was added to the farm value, and that a small dwelling did not add as much to the total value of a large farm as of a small one. This analysis involved the use of multiple curvilinear correlation and "solid" multiple curvilinear correlation, which is too complicated to present here in detail (*5*, *8*). Only the final conclusions reached will be presented.

A multiple correlation of $P = 0.772$ for the relation between the eight factors and farm values per acre was obtained. This means that only about 60 per cent of the causes of variation in land value could be accounted for on the basis of this study,[21] but it did make possible a much closer measurement of the relations on the non-mushroom farms than the first results gave, this final result being about 50 per cent more accurate for these farms than the first solution. The relative importance of the several factors in determining farm value per acre, as shown by their coefficients of net determination, was as follows:

Factor:	Per cent
A. Dwelling value	11.95
B. Dairy buildings value	12.45
C. Other buildings value	19.21
D. Crop index	4.55
E. Percentage of area tillable	2.81
F. Percentage of area level	6.16
G. Type of road	0.47
H. Distance to town	2.08

This solution is in much better agreement with the known facts of the case. This is an area of very uniform soil, practically all of the same type, and as a result differences in soil fertility are not so important as a cause of differences in land value as they might be in other regions where soils are much more variable. Likewise, the topography of this area is irregular, and as a result the proportion of the land area which is level is much more important than it might be in other regions of more uniform topography.

Of the casual factors included, buildings as a whole are responsible for 44 per cent of the variations in farm value; the land, including fertility, topography, and proportion usable, 13½ per cent; and general farm factors of location and road, 2½ per cent. These conclusions, however, are reached in a study where 40 per cent of the variation in value is still left to be accounted for. Inclusion in the analysis of some of the other casual factors might materially change the apparent relative importance of some of these factors.

As would be expected in a dairy region like this, the dairy buildings proved to be even more important than the dwelling house in determining farm value. Rather surprisingly, though, the value of other buildings is more important than either. This may be caused by the fact that the coefficient of determination measures not only the variation due to the influence of the individual factor considered, but also variations due to the influence of any other factors not included in the study which are highly correlated with the individual factor. Thus the farms in this group with high values for "other buildings" are mainly those with large poultry plants. It may be that these farms tend to be located near the larger towns, and that therefore their values are higher, out of proportion to their distance from town. The higher variability of the value of "other buildings" also tends to exaggerate their significance. Much more detailed analysis would be required to answer all questions of this sort that might be raised. In general, however, these conclusions are in substantial agreement with the expectations based on conditions within the area.

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[21] The significance of a coefficient of correlation is shown by the square of its value. Thus a correlation 0.772 shows that $(0.772)^2$, or 0.596, of the original variation has been accounted for, and that $1-(0.772)^2$ or 0.404, of the original variation has not been accounted for.

Since the regressions obtained by this analysis are curvilinear, they can not be shown as regression coefficients, but must be given either in tables or graphically.

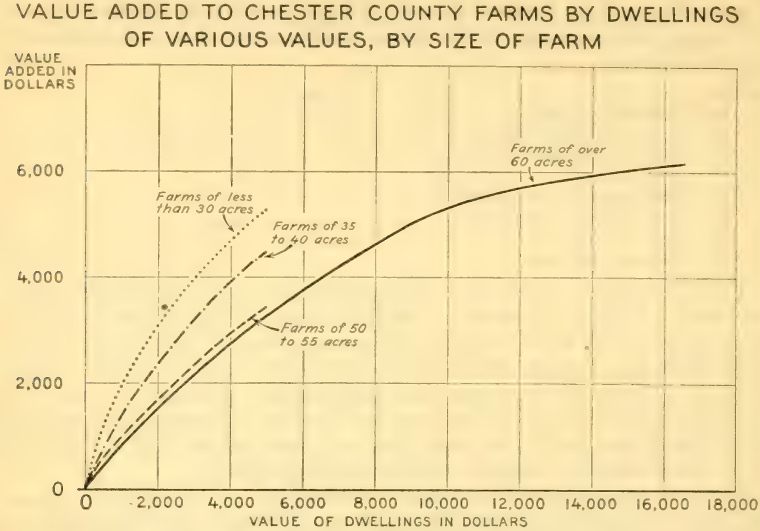

FIG. 9.—The more expensive the dwelling, the smaller the part of its value represented in farm value

Tables 41 to 48 list these regressions, and they are also shown graphically in Figures 9 to 11.

TABLE 41.—*Value added to Chester County farms by dwellings of various values, for farms of various sizes*

Value of dwelling, in dollars	Value added to land value [1]			
	Farms under 30 acres	Farms of 35 to 40 acres	Farms of 50 to 55 acres	Farms of over 60 acres
	Dollars	*Dollars*	*Dollars*	*Dollars*
500	1,250	775	550	500
1,000	1,950	1,450	950	850
1,500	2,600	1,925	1,350	1,175
2,000	3,050	2,375	1,655	1,500
2,500	3,550	2,750	2,000	1,825
3,000	4,000	3,250	2,325	2,150
4,000	4,750	3,900	2,950	2,750
5,000	5,250	4,450	3,400	3,250
6,000			4,000	3,750
8,000				4,650
10,000				5,310
12,000				5,680
14,000				5,910
16,000				6,060
18,000				6,170

[1] Average value without dwelling, $86.75 per acre, other factors being at their average value.

Table 41 shows the relation between the value of the dwellings on these farms, as estimated by the farmers, and the estimated sales values. Figure 9 shows the same data graphically.

As shown by these results, farm dwellings on the smaller farms worth up to $5,000 added as much as their value or more to the farms on which they were built, especially for farms under 30 acres. Most of these farms were more nearly country residences than true farms, and were in demand for their value as residences rather than for their value as farm property.

For larger farms the dwellings did not add their full value to the farm value, a $4,000 dwelling adding only $3,900 to the value of a 40-acre farm or $2,750 to the value of a 60-acre farm. Above $8,000 the value of the dwelling had very little further effect on the value of the farm, an $8,000 dwelling adding $4,650, a $12,000 dwelling about $5,700, and a $16,000 dwelling about $6,000. Apparently $6,000 was about as much as the average farmer could afford to pay for a house, despite the actual replacement cost of the building involved.

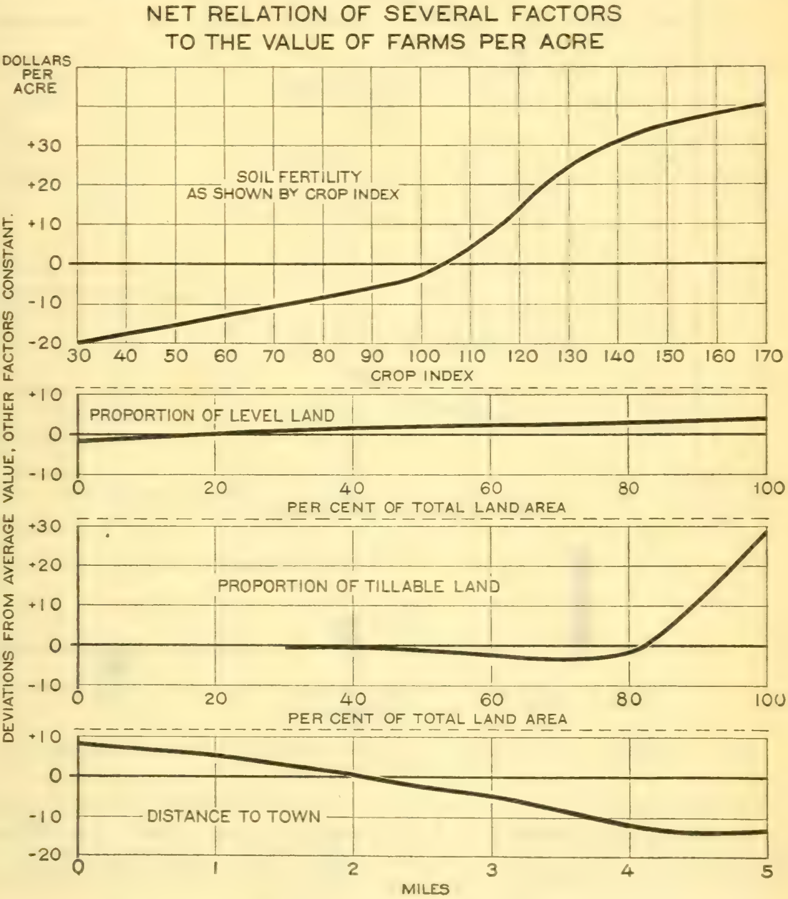

FIG. 10.—Holding constant the effect of all other factors, these net regression curves show how farm values per acre varied with each factor

The figures given in Table 41 were used as the basis for separating the value of the dwelling from the value of the part of the farm used for agricultural production. By the use of this table it was possible to eliminate from the farm value that part of it which was due to the value of the dwelling. This was the means by which the separate dwelling values shown in the previous statement were obtained.

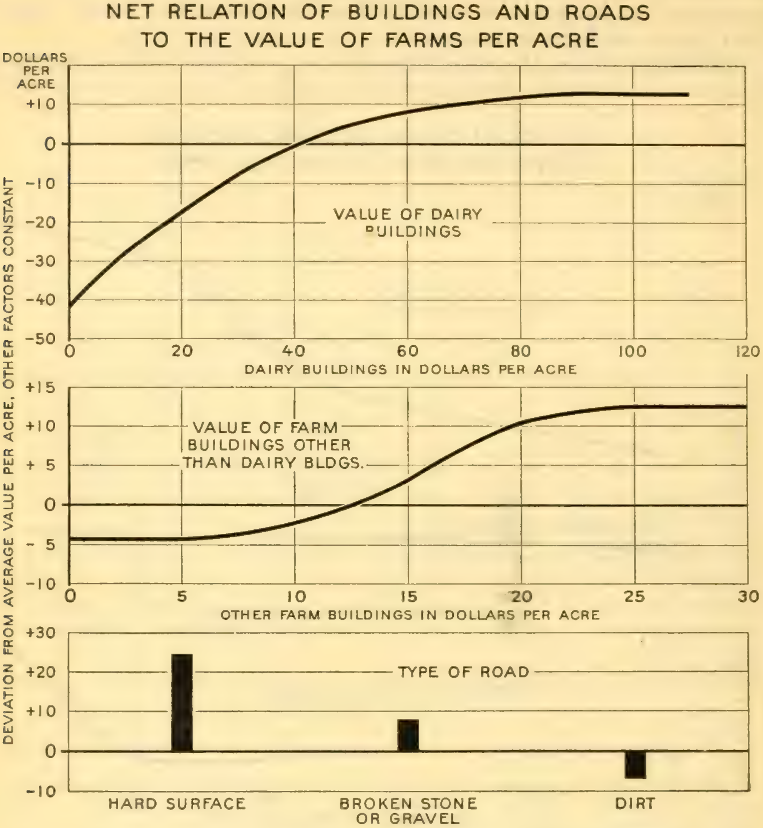

FIG. 11.—The value of dairy buildings and the value of other farm buildings are both important factors affecting farm values

The effects of the other factors upon farm values shown in Tables 42 to 48 throw interesting light upon the way that the different factors affect land values in this area. Since this bulletin is primarily a study of the farm management of the area, no detailed discussion will be devoted to these relations.

TABLE 42.—*Net relation of the acre-value of dairy buildings to the farm value per acre*

Value of dairy building, in dollars per acre.	Deviation of farm value from average per acre, other factors being the same	Value of dairy building, in dollars per acre.	Deviation of farm value from average per acre, other factors being the same
	Dollars		*Dollars*
0	−41.7	50	+5.2
10	−28.0	60	+7.7
20	−17.8	70	+9.9
30	−7.6	80	+12.0
40	−.8	90 and over	+12.8

TABLE 43.—*Net relation of the type of road to farm value per acre*

Type of road	Deviation from average value, per acre, other factors being the same
	Dollars
Concrete, asphalt, or macadam	+24.5
Broken stone or gravel	+8.0
Dirt	−6.9

TABLE 44.—*Net relation of the acre-value of buildings other than dwellings or dairy barns to the farm value per acre*

Other buildings value per acre, in dollars	Deviation of farm value from average per acre, other factors being the same
	Dollars
0	−4.3
5	−4.3
10	−2.2
15	+3.1
20	+10.4
25	+12.6
30	+12.6

TABLE 45.—*Net relation of the crop index to the farm value per acre*

Crop index	Deviation from average value per acre, other factors being the same
	Dollars
30	−20.3
40	−17.8
50	−15.4
60	−13.1
70	−10.5
80	−8.2
90	−5.9
100	−2.6
110	+4.2
120	+13.8
130	+24.5
140	+30.8
150	+35.7
160	+38.1
170	+40.6

TABLE 46.—*Net relation of the proportion of the farm level to the farm value per acre*

Proportion of farm area level, in per cent	Deviation from average value per acre, other factors being the same
	Dollars
0	−1.3
10	−.6
20	+.1
30	+.8
40	+1.6
50	+1.9
60	+2.3
70	+2.6
80	+3.0
90	+3.4
100	+3.7

TABLE 47.—*Net relation of the percentage of farm tillable to the farm value per acre*

Proportion of farm area tillable, in per cent	Deviation from average value per acre, other factors being the same	Proportion of farm area tillable, in per cent	Deviation from average value per acre, other factors being the same
	Dollars		*Dollars*
30	−0.2	80	−2.0
40	−.2	85	+3.5
50	−1.3	90	+10.7
60	−2.5	95	+19.8
70	−3.8	100	+28.9

TABLE 48.—*Net relation of the distance to town to the farm value per acre*

Distance to town, in miles	Deviation of farm value from average per acre, other factors remaining unchanged	Distance to town, in miles	Deviation of farm value from average per acre, other factors remaining unchanged
	Dollars		*Dollars*
0	+8.1	3	−4.4
1	+5.2	4	−11.7
2	+.4	5	−13.2

FACTORS AFFECTING EARNINGS ON ALL FARMS

The initial correlation analysis with earnings as the dependent was made in connection with the study of the differences in the organization of the different farms, to determine (1) the relative importance of differences in the different enterprises in affecting operator's earnings, (2) the average effect of changes in the proportion of the different enterprises upon operator's earnings.

Since it was evident that size of farm and efficiency of operation also affected operator's earnings, factors to measure them were included in the correlation analysis, to eliminate their effects in measuring the other relations.

All farms except those that reported mushrooms, and a few which were discarded as unusable for reasons mentioned previously, were included, giving 357 observations for the correlation study. The factors taken into account were as follows:

Size factors:
  A. Number of cows.
  B. Acres in crops.
  C. Acres in pasture.
Efficiency factors:
  D. Crop index.
  E. Labor index.
  F. Percentage of dairy feed purchased.
Organization factors, dollars of receipts from:
  G. Crops.
  H. Dairy products or cattle.
  I. Beef Cattle.
  K. Hogs.
  L. Sheep.
  M. Poultry.
Dependent factor:
  O. Operator's earnings.

The 12 factors gave a multiple correlation with operator's earnings of $R = 0.843$.

The relative importance of the different factors in determining operator's earnings, as shown by the coefficients of determination, were as follows:

Factor:	Per cent
A. Number of cows	[22] (−)7. 0
B. Acres in crops	(−)11. 1
C. Acres in pasture	(−). 5
D. Crop index	. 1
E. Labor index	1. 4
F. Percentage of dairy feed purchased	. 2
G. Receipts from crops	18. 7
H. Receipts from dairy herd	57. 0
I. Receipts from beef cattle	. 0
K. Receipts from hogs	1. 9
L. Receipts from sheep	. 0
M. Receipts from poultry	10. 4
Combined importance of all	71. 0

These results showed that the size of farm, both as regards the number of cows and the acres in crops, were important in determining earnings in this area. They further show that, during 1922–23 at least, differences in the labor index, in the labor employed relative to the size of the enterprise, were of only negligible importance. Likewise, for the year of the survey it made practically no difference what part of the feed for the dairy cows was purchased and what part was raised. This result proves the earlier statement to the same effect illustrated by tabular material (p. 21).

Differences in the different "organization" factors were responsible for most of the differences in returns. Of the livestock enterprises, differences in dairy returns and poultry returns were most important. Hogs were the only other livestock enterprise that had any measureable significance. It is noteworthy that even in this analysis, including many farms that were not primarily dairy farms, the dairy enterprise should stand out as more important than all the other enterprises put together.

The effect of crop sales upon returns and the result for crop index show that larger areas of cash crops rather than higher yields were primarily responsible for the importance of crop sales. Even in this year when crops were selling at relatively low prices, income from crop sales had a greater effect upon earnings than did income from any other source except the dairy enterprise.

The coefficients of net regression, which show the average change in earnings for a given change in each factor, after eliminating the effect of other factors, give further information on the relation of each factor to operator's earnings. (Table 49.)

TABLE 49.—*Net regression of operator's earnings on several factors*

On the average, for each increase of—	Operator's earnings increased	On the average, for each increase of—	Operator's earnings increased
	Dollars		*Dollars*
1 cow	−22	$100 in crop recripts	+69
10 acres in crops	−153	$100 in dairy receipts	+63
10 acres in pasture	−24	$100 in beef receipts	+1
10 points on crop index	+2	$100 in hog receipts	+64
One month in "labor index"	−44	$100 in sheep receipts	+22
10 per cent in dairy feed purchased	−8	$100 in poultry receipts	+67

[22] The negative sign (—) indicates determination in the negative direction; that is, holding constant the receipts from the dairy, the more cows the less the income, hence the negative sign—the determination from this variable is a deduction from the effect for variable H.

A little further discussion is required to explain why these results come out as they do, since for several of the items the results appear inconsistent. Thus the regressions for cows, area, and labor index are all negative, because each measures the effect of changing one of these factors *without changing any of the others;* that is, adding one cow to the dairy *without selling any more milk* would reduce returns by $22 on the average; employing an additional man for a month, without selling any more products, would decrease returns by the extent of his wages, or about $44.

After eliminating the effects of these factors the results show that an additional $100 income from crops, dairy enterprise, poultry, or hogs added just about the same to the operator's earnings. This does not mean that this represented the profit on each $100 sale of these items, but that on the average of the area $100 added to the receipts of one of them, while holding all other factors constant, would have added the amount indicated to the operator's earnings. Under these conditions the extra return would have had to be due almost entirely to his own extra efforts, since the extra product would have to be produced from the same area of land or herd of cows, without the use of more labor; therefore it is but natural that a large part of such extra return would go to the operator himself. To some extent this does measure the effect upon their farm earnings of the extent to which different men exert themselves; the returns shown being the measure of this greater output from the same equipment when the extra energy is employed in different enterprises. It is also interesting to note that on the average each of these four enterprises had about the same balance between receipts and operator's earnings—an additional $100 income from any one of the four adding between $60 and $70 to earnings

It is significant that neither the beef nor sheep enterprises were anything like so productive, giving statistical proof of the conclusion reached earlier that these two enterprises are not economically suited to Chester County conditions.

One other correlation was made with the data from the 357 farms to see how far differences in operators' earnings could be accounted for on the basis of differences in receipts from the different enterprises without taking into account size or efficiency of the farm. The six factors representing receipts—G, H, I, K, L, and M—correlated with operators' earnings, gave a multiple correlation of $R = 0.729$. The coefficients of determination of the six factors in this solution were:

Factor:	Relative importance, per cent
G. Crop receipts	7. 3
H. Dairy receipts	33. 6
I. Beef receipts	. 9
K. Hog receipts	1. 4
L. Sheep receipts	. 0
M. Poultry receipts	10. 0
Combined importance	53. 2

The relative importance of the different factors in this seven-variable solution differed but little from the earlier solution where 13 variables were considered, except that in this one poultry receipts ranked ahead of crop receipts in importance. As compared with the

71 per cent of the variation in earnings which could be accounted for on the basis of size, efficiency, and combination of enterprises, in this last solution 53 per cent could be accounted for on the basis of combination of enterprises and size alone (size being implicit in the solution, since the income from the different enterprises was stated in terms of total dollars instead of in percentages, and therefore varied with the size of farm).

It was evident from this study that dairying was the dominant enterprise in the area, and that the most profitable organization for farms of the typical size and equipment (barring mushrooms) would be one centered around the dairy enterprise. For that reason no further attempt was made to study the most satisfactory combination of enterprises on this group of farms, including everything from straight crop or beef farms to intensive poultry farms, but instead the further work was concentrated upon the dairy farms.

FACTORS AFFECTING EARNINGS ON DAIRY FARMS

Only the 270 farms representing the characteristic dairy farms of the region were included in this analysis. The following factors were taken into account:

A. Number of cows.
B. Acreage in crops.
C. Acreage in pasture.
D. Crop index.
E. Dairy index.
F. Labor index.

These six factors gave a multiple correlation with operator's earnings of $R=0.80$. The coefficients of determination for each factor were as follows:

Factor:	Relative importance, per cent
Number of cows	16. 2
Crop acreage	3. 4
Pasture acreage	(—)2. 7
Crop index	7. 3
Dairy index	38. 9
Labor index	. 5
Total	63. 6

This shows once more the striking importance of the dairy enterprise in getting profitable returns on these farms. The efficiency with which the dairy is operated, even more than the number of cows, determines farm profits. In fact, the single factor, the dairy index, has a correlation of $r=0.64$ with operator's earnings merely by itself, while the two factors of number of cows and dairy index have a multiple correlation of $R_{o \cdot ae \cdot}=0.73$. In other words, merely the size and efficiency of the dairy enterprise alone account for over half of all the variation in operators' earnings on the dairy farms, without taking any other factors into consideration.

Further study by the method of curvilinear correlation showed that differences in efficiency of operation were not nearly so important on farms with small herds as with large herds. Holding other factors constant, on farms with 5 cows a change in dairy index from $25 to $100 increased operators earnings $510, on the average, although the same increase on farms with 15 cows increased earnings $850. Similarly, an increase from 5 to 20 cows increased earnings only $340 with a dairy index of $25, but increased earnings $700 with an index of $100, and $1,130 with an index of $150. These net results, obtained while eliminating the effect of other factors, verify the conclusions shown by simple tabulation in Table 22. Even a large herd would not return a good income if the milk was not produced efficiently and economically; with efficient production, the larger the herd the larger the earnings.

Taking into account the difference in the relation of dairy index to operator's earnings for small and for large farms raised the multiple correlation slightly, but the increase was not significant enough to indicate that the exact relation could be measured very closely from the available data. For that reason the regression surface, from which the values quoted in the preceding paragraph were read, was not considered of sufficient accuracy to publish.

The "coefficients of determination" for the crop and pasture acreage in this last solution confirm the conclusion, previously illustrated by simple tabulation, that difference in the size of farms outside of the size of the herd had very little effect upon farmer's earnings the year of the survey. This checks the conclusion shown by the result as to the proportion of the dairy feed purchased and the proportion raised: For the year of the survey it made little difference whether the feed was raised or purchased; it cost the farmer the same. But it should be remembered that this was by no means a typical year, and that with more usual conditions the crop enterprises would undoubtedly add something to the farmer's earnings.

The result as to crop index shows, as is invariably the case, that the farmers with higher yields tended to receive the larger profits. This was more important than any other factor except the size and efficiency of the dairy business. To the extent that these higher yields are owing to natural superior fertility of the soil not offset by a higher charge for the use of land, this indicates not better ability on the part of the operator but merely that he benefits from using superior resources.

As has already been shown, farms with a crop index of 110 were worth about $10 an acre more than farms with a crop index of 90, other things being equal. For a typical farm of 100 acres that would mean a difference in value of about $1,000. As shown by the net regression for this group of dairy farms, an increase of 20 points in crop index would increase earnings about $180, on the average. From this it would appear either that (1) a large part of the differences in yields were owing to the skill of the individual farmers and were not reflected in land values, or (2) part of the observed variation in yields was owing to conditions of the individual year and were not representative of the individual farms, or (3) the appraisal of individual farms and the competition for farms is not keen enough in this area to reflect in the price of the farm all of the differences in fertility. This latter point might also be explained in terms of the importance of the differences in the ability of men as well as of land in determining the rents to be paid (*18*, pp. 194–198). Each of the alternatives is probably true in some measure. At any event, it apparently pays to give some attention to procuring good yields in Chester County; but, at least on dairy farms, the room for improvement in this direction is nothing like so great as the room for improvement in selecting, breeding, and feeding the dairy herd, variations in the efficiency of milk production being over five times as important as a determinant of farm profits as variations in the yields of crops.

The result obtained for the labor index in this case confirms the earlier conclusion that labor is in general used with very uniform efficiency throughout the area. Differences in the efficiency with which labor is used on the dairy farms alone are only one-third as important in their effect on operators' earnings as were variations in labor efficiency on all farms thrown together. This indicates that although labor in general is used with very uniform efficiency on the dairy farms, it is not used quite so efficiently on the crop, small dairy, or other special types (excluding mushroom farms), and that there is more room for improvement in the utilization of labor on these other farms. This is but natural, since the dairy farms come closer to providing year-round full-time employment in profitable work than do any of the other types except the mushroom farms.

Further study was made of the "net" relation between the number of cows, acres in pasture and in crops, and operators' earnings, to see if there was any indication of the "best" combination of these factors after eliminating the other disturbing elements. Although there was some very slight indication that farms of 100 acres or more returned the largest earnings when about one-third of their area was in pasture, the observations for smaller farms were conflicting, and curvilinear correlations showed that the proportion between pasture and crop land had no perceptible influence upon earnings. Study of the relations between number of cows and acres gave similar negative conclusions. These results indicate that in an area of as varied topography as Chester County it is not possible to lay down definite standards for farm organization from the results of statistical studies of this type, but that instead each farm must be treated as a separate unit and the most profitable organization for it worked out by direct study of its own resources and possibilities along the lines suggested in various publications of the United States Department of Agriculture and other agencies (*3*, *10*).

RELATION OF FEEDING PRACTICES TO EFFICIENCY OF MILK PRODUCTION

The tabular study in the section devoted to causes of variations in the efficiency of milk production demonstrated that the "dairy index" was the resultant of two groups of forces—those determining the price at which the milk sold and those determining the efficiency with which it was produced. And as further shown there, the production per cow was one of the most important factors determining the feed cost of milk production.

The following statistical study was made to measure the importance of the different factors affecting milk production under farm conditions as far as it could be done from the data available, and to demonstrate the importance of good dairy husbandry directly from the farm records themselves.

Following the methods previously worked out for studying the efficiency of enterprise operation, the analysis would include three stages:

(1) Determination by statistical means of the relation between input and output.

(2) Application of prevailing costs and prices to the inputs at various combinations of input factors to determine the least cost or greatest profit combination under prevailing conditions.

(3) Making the same computation with other possible price conditions to determine the most profitable combination under other conditions (*20*).

The following factors were used in the analysis:

A. Therms of net energy consumed per cow per year (exclusive of pasture).
B. Ratio of digestible protein (in pounds) to net energy (in therms).
C. Butterfat test of milk.
D. Proportion of the herd freshening in the fall.
E. Average value per cow (to measure quality).

Each factor was expressed in logarithms, to obtain "multiplying" relationships (*6*).

Using solid multiple curvilinear correlation, an index of multiple correlation of $P=0.615$ was obtained with milk production for the year.

One important reason why the correlation was not higher was that it was not possible to obtain any satisfactory measure of the contribution of pasturage to milk production. Estimates of pasturage based on length of time the cows were on pasture and the acres of pasture per cow gave results of no significance on correlation, but correlation with winter milk production indicated that the other factors included were responsible for at least half the variation in milk production while the cows were not on pasture.[23]

With the low correlation obtained, neither the regressions nor the relative determination by the different variables constituted a very exact measurement, and they are therefore not presented separately at this point. The regression curves, however, did furnish a means for at least approximately eliminating the effect of other variables from the tables showing the relation of various factors to the feed cost of milk production, and they were therefore used for this purpose in preparing Tables 27 to 31, and in estimating the most probable milk production for the rations given in Table 27.

The results secured in this study of the dairy enterprise fell far short of perfect correlation, but they did serve to eliminate from these tables the effects of such other variables as could be measured. Instead of assuming that "all other factors" would average out, so that the tables would be significant, this merely assumes that variations due to unmeasured factors will tend to average out. To that extent the tables are both more significant and more reliable than similar results obtained by merely sorting and averaging.

The tables following, 50 to 54, show averages of the labor index, crop index, crop acreages, pasture acreages, and crop acres per cow, for farms sorted by number of cows and dairy index. Comparing these tables, with Table 22, page 24, gives a direct comparison of the influence of these different factors upon the operator's earnings shown for these groups of farms.

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[23] The four factors A, B, C, and D, gave a coefficient of multiple correlation of $R=0.646$ with the production for the winter alone. Since these four variables had only given $R=0.553$ on linear correlation with production for the year, it is likely that application of the curvilinear method to the winter production alone would have raised the correlation to about 0.72, since $(0.553)^2 : (0.615)^2 = (0.646)^2 : (0.719)^2$

TABLE 50.—*Average labor index, for dairy farms classified by number of cows and dairy index*

Dairy index, in dollars	Average labor index, by size of herd								
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows	35 to 40 cows	40 to 45 cows	45 to 50 cows
−50 to 0			+18.0						
0 to 50	−3.1	+0.4	+2.2	−4.8	+15.0	−2.0			
50 to 100	−1.0	−.4	+.1	+.7	+9.0	+9.0			−10.0
100 to 150	+.4	+1.7	+.4	+6.0	−1.0		+21.0		
150 to 200	+.5	−2.0	+8.7	+12.0	+6.5	+17.0			
200 to 250		+1.0	+10.0						

TABLE 51.—*Average crop index for dairy farms classified by number of cows and dairy index*

Dairy index, in dollars	Average crop index, by size of herd								
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows	35 to 40 cows	40 to 45 cows	45 to 50 cows
—50 to 0			88.0						
0 to 50	85.6	92.8	96.0	100.8	120.0	96.0			
50 to 100	86.0	98.0	98.4	99.2	105.2	122.0			104.0
100 to 150	95.6	101.2	107.2	104.4	100.0		100.0		
150 to 200	98.0	102.0	100.0	116.0	108.0	136.0			
200 to 250		132.0	116.0						

TABLE 52.—*Average acreage in crops, for dairy farms, classified by number of cows and dairy index*

Dairy index, in dollars	Average acreage in crops, by size of herd								
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows	35 to 40 cows	40 to 45 cows	45 to 50 cows
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
—50 to 0			84.0						
0 to 50	43.5	60.3	81.6	66.6	100.5	162.0			
50 to 100	39.6	55.5	65.1	83.4	89.4	97.5			48
100 to 150	36.9	49.5	70.2	78.3	68.1		171		
150 to 200	79.5	49.5	57.0	45.0	91.5	156.0			
200 to 250		42.0	45.0						

TABLE 53.—*Average acres in pasture for dairy farms, classified by number of cows and dairy index*

Dairy index, in dollars,	Average acreage in pasture, by size of herd								
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows	35 to 40 cows	40 to 45 cows	45 to 50 cows
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
—50 to 0			26.0						
0 to 50	11.0	16.0	28.8	27.0	30.0	74.0			
50 to 100	13.4	20.2	22.4	31.0	42.4	84.0			64
100 to 150	10.8	17.6	25.2	43.6	44.6		36		
150 to 200	23.0	28.0	18.6	20.0	23.0	30.0			
200 to 250		14.0	17.0						

TABLE 54.—*Average crop acres per cow, for dairy farms classified by number of cows and dairy index* [1]

Dairy index, in dollars	Average crop acres per cow, by size of herd					
	5 to 10 cows	10 to 15 cows	15 to 20 cows	20 to 25 cows	25 to 30 cows	30 to 35 cows
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
0 to 50	5.8	4.9	4.7	3.0	3.7	
50 to 100	5.3	4.4	3.7	3.7	3.3	3.0
100 to 150	4.9	4.0	4.0	3.5	2.5	
150 to 200	10.6	4.0	3.3		3.3	
200 to 250			2.6			

[1] Assuming that the number of cows average the midpoint of each group. Averages not shown for groups of only one report.

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